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WAR MACHINE

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'Oberon' on Patrol

'Foxtrot' in Action

Armed Forces of the World: Soviet Air Force (Part 4)

Silent Running – The Diesel Option

A fully illustrated guide to Modern Diesel Submarines

WAR MACHINE

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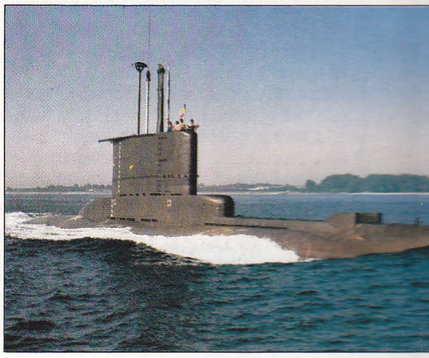
Modern Diesel Submarines

Since the end of World War I it has been recognized that the submarine has the potential for waging true strategic war. With the advent of nuclear power it seemed that the old-fashioned diesel-powered vessel had had its day – but this has not proved to be the case.

The Colombian navy submarine Pijao *(SS28) was commissioned in 1975 and is of the West German 'Type 209' 56-m (183.7-ft) design. Armed with eight bow torpedo tubes and six reloads, she has a maximum underwater speed of 22 kts.*



For most nations today the diesel-powered submarine provides a cost-effective solution to the problem of sea denial by undersea craft. Only the very large and rich nations can afford the nuclear powerplants required to give the submarine relatively unlimited endurance to perform its designated tasks. However, the diesel designs do have the significant advantage of being extremely quiet and when operating in the silent running state are virtually undetectable. Thus the smaller naval powers can, if necessary, use such vessels to effect considerable influence on the peacetime affairs in those maritime areas which interest them, and in times of conflict use their defensive and offensive capabilities to create a real threat to opposing forces.

The reality of the latter is no idle threat, as the 1982 Falklands war showed when the Argentine navy used a single Type 209 submarine to harass the much larger and better equipped British task force. The boat in question, the *San Luis*, made three abortive attacks with wire-guided ASW and anti-ship torpedoes, and caused the Royal Navy to maintain its ASW defensive tactics and airborne patrols for around three months or so, as its intelligence on the whereabouts of the Argentine submarine force was limited, to say the least.

Before this the only other time that a submarine force played a part in a major war after World War II was during the 1971 Indo-Pakistan War: the Pakistani navy had the ex-American World War II 'Tench' class submarine *Ghazi* sunk by Indian forces during a minelaying operation off the major naval base at Vishakhapatnam. In exchange for this loss, Pakistan's 'Daphné' class boat *Hangor* sank the Indian navy frigate *Khukri* in a torpedo attack, the first sinking gained in this fashion since World War II.

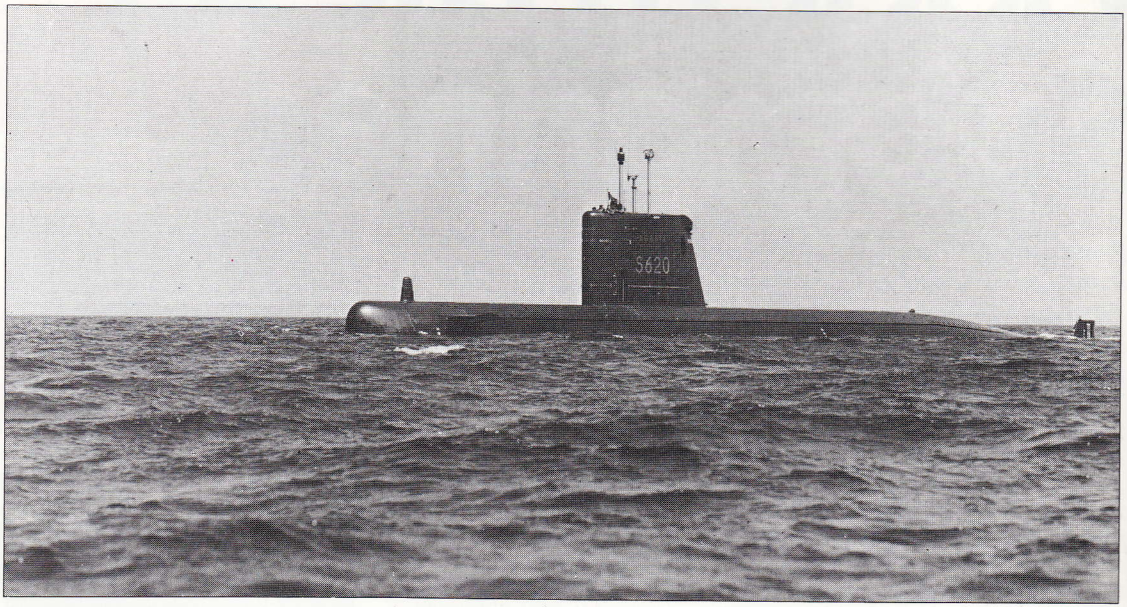
The most successful Western export submarine of the post-war period is the West German 'Type 209', which has been sold to navies in all parts of the world. The Peruvian Casma *(S31), on her trials in the North Sea, is shown with a West German navy Westland Sea King SAR helicopter overhead.*

FRANCE

'Agosta' class

Designed by the French Directorate of Naval Construction as very quiet but high performance ocean-going SSKs, the **'Agosta' class** boats are each armed with four bow torpedo tubes that are equipped with a rapid-reload pneumatic ramming system that can launch weapons with the minimum of noise signature. The tubes are of a completely new design which allows the submarine to fire its weapons at all speeds and at any depth down to its maximum operational limit.

The four boats in service with the French navy as its last conventionally powered submarines are the ***Agosta*** (S620), ***Beveziers*** (S621), ***La Praya*** (S622) and ***Ouessant*** (S623). All were authorized in the 1970-5 naval programme as the follow-on class to the 'Daphnés'. One, *La Praya*, has since been refitted with a removable swimmer delivery vehicle container aft of the sail to replace similar facilities that were available aboard the now-deleted submarine *Narval*. The Spanish navy built locally four 'Agostas' in the early 1980s, namely the ***Galerna*** (S71), ***Sciroco*** (S72), ***Mistral*** (S73) and ***Tramontana*** (S74) using French electronics and L5, F17 and E18 torpedoes. Pakistan purchased in mid-1978 two units (built originally for South Africa but embargoed) as the ***Hashmat*** (S135) and ***Hurmat*** S136). Pakistan is known to be interested in acquiring a further two 'Agostas', and an order is believed to have been placed in 1983, but whether France or Spain is to be the building country is not yet known. All the French units are to be equipped during the mid-1980s with the sub-surface-launched SM.39 version of the Exocet anti-ship missile, while the Pakistan navy has apparently turned to the USA for the supply of the Sub-Harpoon missile. Spain is still deciding between the two systems. The four French submarines are due to be deleted in the period 2002-3.



***Agosta** (S620) is lead ship of the last class of conventionally-powered submarines to be built for the French navy. All will be fitted to fire the SM-39 Exocet submerged launched anti-ship missile in the next few years.*

Specification

'Agosta' class

Displacement: 1,480 tons surfaced and 1,760 tons dived

Dimensions: length 67.6 m (221.8 ft); beam 6.8 m (22.3 ft); draught 5.4 m (17.7 ft)

Propulsion: two diesels delivering 3430 kW (4,600 hp) with one electric motor driving one shaft

Speed: 12.5 kts surfaced and 17.5 kts dived

Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum

Torpedo tubes: four 550-mm (21.7-in) with 533-mm (21-in) liners

Basic load: 23 550-mm (21.7-in) or 533-mm (21-in) anti-submarine and anti-ship torpedoes, or 46 influence ground mines

Missiles: SM.39 Exocet underwater-to-surface anti-ship missiles

Electronics: one DRUA 23 surface-search radar, one DUUA 2A sonar, one DUUA 1D sonar, one DUUX 2A sonar, one DSUV 2H sonar, one ARUR ESM system, one ARUD ESM system, and one torpedo fire-control/action information system

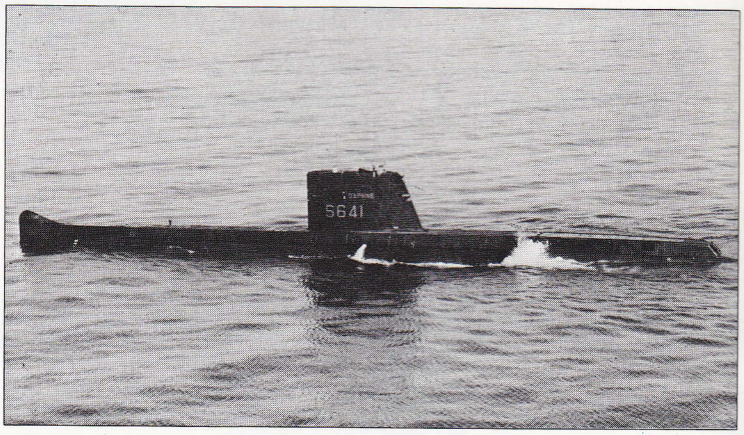
Complement: 54

FRANCE

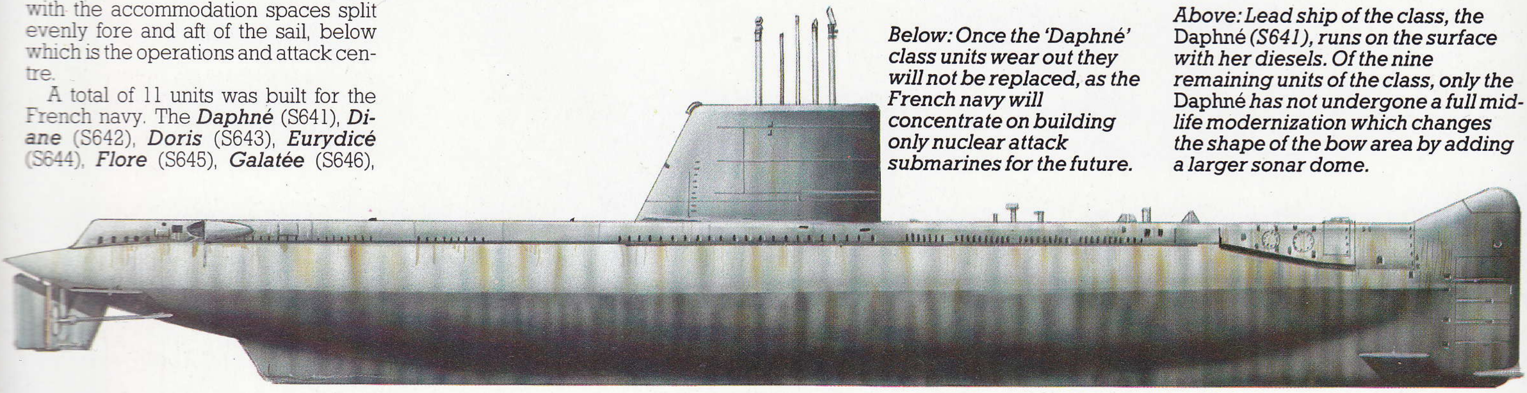
'Daphné' class

In 1952 plans were requested from STCAN for a second-class ocean-going submarine to complement the larger 'Narval' class. Designated the **'Daphné' class**, the boats were purposely designed with reduced speed in order to achieve a greater diving depth and heavier armament than was possible with the contemporary 'Aréthuse' design of conventionally-powered hunter-killer submarines. To reduce the crew's workload the main armament was contained in 12 externally-mounted torpedo tubes (eight forward and four aft), which eliminated the need for a torpedo room and reloads. Further crew reductions were made possible by adopting a modular replacement system for onboard maintenance. The design uses the double-hull construction technique with the accommodation spaces split evenly fore and aft of the sail, below which is the operations and attack centre.

A total of 11 units was built for the French navy. The ***Daphné*** (S641), ***Diane*** (S642), ***Doris*** (S643), ***Eurydicé*** (S644), ***Flore*** (S645), ***Galatée*** (S646), ***Minérve*** (S647), ***Junon*** (S648), ***Vénus*** (S649), ***Psyché*** (S650) and ***Sirène*** (S651) entered service between 1964 and 1970. Of these two were lost (the *Minérve* in 1968 and the *Eurydicé* in 1970) with all hands while operating in the western Mediterranean. The remaining boats all underwent an electronics and weapons modernization from 1970 onwards. Besides those for the French navy, a further 10 were built for export. Portugal received the ***Albacore*** (S163), ***Barracuda*** (S164), ***Cachalote*** (S165) and ***Delfin*** (S166), of which S165 was sold to Pakistan in 1975 as the ***Ghazi*** (S134). Pakistan also has the ***Hangor*** (S131), ***Shushuk*** (S132) and ***Mangro*** (S133). South Africa operates the ***Maria Van Riebeeck*** (S97), ***Emily Hobhouse*** (S98) and ***Johanna***



Above: Lead ship of the class, the Daphné *(S641), runs on the surface with her diesels. Of the nine remaining units of the class, only the* Daphné *has not undergone a full mid-life modernization which changes the shape of the bow area by adding a larger sonar dome.*



Below: Once the 'Daphné' class units wear out they will not be replaced, as the French navy will concentrate on building only nuclear attack submarines for the future.

Van der Merwe (S99). A further four, the ***Delfin*** (S61), ***Tonina*** (S62), ***Marsopa*** (S63) and ***Narval*** (S64) were built under licence in Spain and are currently undergoing a modernization similar to that applied to the French boats. In 1971 the Pakistani submarine *Hangor* sank the Indian navy frigate *Khukri* during the Indo-Pakistan War: this was the first submarine attack since World War II.

Specification
'Daphné' class
Displacement: 869 tons surfaced and 1,043 tons dived
Dimensions: length 57.8 m (189.6 ft); beam 6.8 m (22.3 ft); draught 4.6 m (15.1 m)
Propulsion: two diesels delivering 1825 kW (2,448 hp) with two electric motors driving two shafts
Speed: 13.5 kts surfaced and 16 kts dived
Diving depth: 300 m (984 ft) operational and 575 m (1,886 ft) maximum
Torpedo tubes: 12 550-mm (21.7-in) located as eight in the bows and four in the stern
Basic load: 12 550-mm (21.7-in) anti-submarine and anti-ship torpedoes, or 24 ground influence mines
Electronics: one Calypso II surface-search radar, one DUUX 2 sonar, one DSUV 2 sonar, one DUUA 1 sonar, one DUUA 2 sonar, and one torpedo fire-control/action information system
Complement: 45

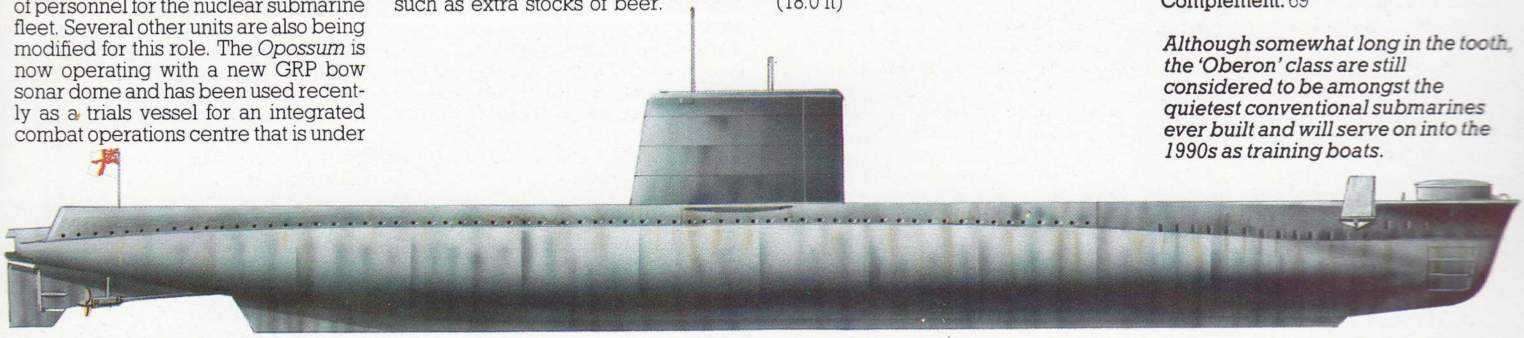
UK

'Oberon' class

Built in the late 1950s to the mid-1960s as the follow-on design to the 'Porpoise' class, the **'Oberon' class** was outwardly identical with its predecessor while internally there are a number of differences. These include the soundproofing of all the equipment for silent running and the use of a higher-grade steel for the hull to allow a greater maximum diving depth. A total of 13 units was commissioned into the Royal Navy between 1960 and 1967. They were HMS ***Oberon*** (S09), ***Odin*** (S10), ***Orpheus*** (S11), ***Olympus*** (S12), ***Osiris*** (S13), ***Onslaught*** (S14), ***Otter*** (S15), ***Oracle*** (S16), ***Ocelot*** (S17), ***Otus*** (S18), ***Opossum*** (S19), ***Opportune*** (S20) and ***Onyx*** (S21). The 'Oberon' has since been modified with a deeper casing to house equipment for the initial training of personnel for the nuclear submarine fleet. Several other units are also being modified for this role. The *Opossum* is now operating with a new GRP bow sonar dome and has been used recently as a trials vessel for an integrated combat operations centre that is under development for use in future submarine classes. The *Orpheus* has also been fitted with a special five-man lock-out diving chamber in its forecasing for covert operations, and for training by the Special Boat Squadron and Special Air Service. The *Onyx* served in the South Atlantic during the Falklands war on periscope beach reconnaissance operations and for landing special forces, and while performing these duties she rammed a rock, which caused a live torpedo to become stuck in one of her bow tubes. This weapon had to be removed in dry dock after she had returned to Portsmouth. The two shortened 533-mm (21-in) stern tubes that were used for Mk 20S anti-escort torpedoes have recently been converted to carry additional stores such as extra stocks of beer.

The 'Oberon' design has also been sold to several foreign navies. Chile bought the ***O'Brien*** (22) and ***Hyatt*** (23); Brazil the ***Humaita*** (S20), ***Tonelero*** (S21) and ***Riachuelo*** (S22); Canada the ***Ojibwa*** (72), ***Onondaga*** (73) and ***Okanagan*** (74); and Australia the ***Oxley*** (S57), ***Otway*** (S59), ***Onslow*** (S60), ***Orion*** (S61), ***Otama*** (S62) and ***Ovens*** (S70). The Canadian and Australian units have been modernized to a higher standard than that prevailing in the Royal Navy's units.

Specification
'Oberon' class
Displacement: 2,030 tons surfaced and 2,410 tons dived
Dimensions: length 90.0 m (295.25 ft); beam 8.1 m (26.5 ft); draught 5.5 m (18.0 ft)
Propulsion: two diesels delivering 5488 kW (7,360 hp) with two electric motors driving two shafts
Speed: 12 kts surfaced and 17.5 kts dived
Diving depth: 200 m (656 ft) operational and 340 m (1,115 ft) maximum
Torpedo tubes: eight 533-mm (21-in) located as six in the bows and two short in the stern
Basic load: 22 533-mm (21-in) anti-submarine and anti-ship torpedoes; British boats carry only 18 torpedoes
Electronics: one Type 1006 surface-search radar, one Type 187 sonar, one Type 2007 sonar, one Type 186 sonar, one torpedo fire-control/action information system, and one ESM system
Complement: 69



Although somewhat long in the tooth, the 'Oberon' class are still considered to be amongst the quietest conventional submarines ever built and will serve on into the 1990s as training boats.

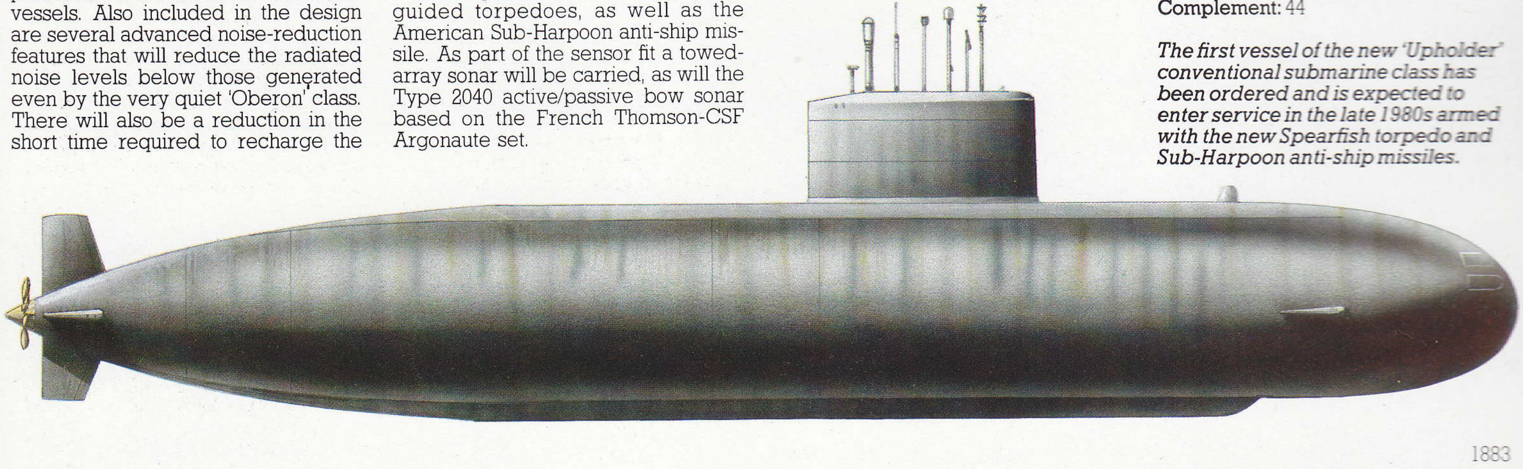
UK

'Upholder' class

To meet a requirement for a new conventional submarine class for the Royal Navy, Vickers Shipbuilding and Engineering Ltd has developed the **'Type 2400'** or **'Upholder' class**. As with most new submarine classes, the emphasis has been placed on standardization and automation to reduce crew numbers. The first of the class was ordered in 1983 with an estimated completion date of 1988. A class total of 12 units is envisaged at present to replace most of the earlier 'Oberon' class vessels. Also included in the design are several advanced noise-reduction features that will reduce the radiated noise levels below those generated even by the very quiet 'Oberon' class. There will also be a reduction in the short time required to recharge the batteries to ensure the absolute minimum exposure time of any part of the masts above the water. The armament fit includes a new positive discharge and fully automated weapon-handling system which avoids the stability problems that arise at torpedo launch and the limitations that are sometimes made on the platform's speed and manoeuvrability. The weapons carried will include the heavyweight Tigerfish electric and the Spearfish thermal-powered dual-role wire-guided torpedoes, as well as the American Sub-Harpoon anti-ship missile. As part of the sensor fit a towed-array sonar will be carried, as will the Type 2040 active/passive bow sonar based on the French Thomson-CSF Argonaute set.

Specification
'Upholder' class
Displacement: 2,160 tons surfaced and 2,400 tons dived
Dimensions: length 70.3 m (230.6 ft); beam 7.6 m (25.0 ft); draught 5.4 m (17.7 ft)
Propulsion: two diesels with one electric motor driving one shaft
Speed: 12 kts surfaced and 20 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow
Basic load: 18 533-mm (21-in) anti-submarine and anti-ship torpedoes, or 36 influence ground mines
Missiles: Sub-Harpoon underwater-to-surface anti-ship missiles
Electronics: one Type 1006 surface-search radar, one Type 2040 bow sonar, one Type 2024 towed-array sonar, one Type 2019 sonar, one DCC torpedo fire-control/action information system, and one ESM system
Complement: 44

The first vessel of the new 'Upholder' conventional submarine class has been ordered and is expected to enter service in the late 1980s armed with the new Spearfish torpedo and Sub-Harpoon anti-ship missiles.



'Oberon' on Patrol

Britain is one of the few nations with a significant nuclear submarine capability, but like the other nuclear navies (with the notable exception of the United States) maintains a large conventional submarine force. The 'Oberon' class, now over 20 years old, has provided the backbone of that force since the mid-1960s.

The limited space on the hull of a surfaced submarine is underlined in this photograph of a crewman being winched aboard a helicopter. Practice in such manoeuvres is essential, as sick bay facilities aboard a crowded sub are not geared to serious cases.

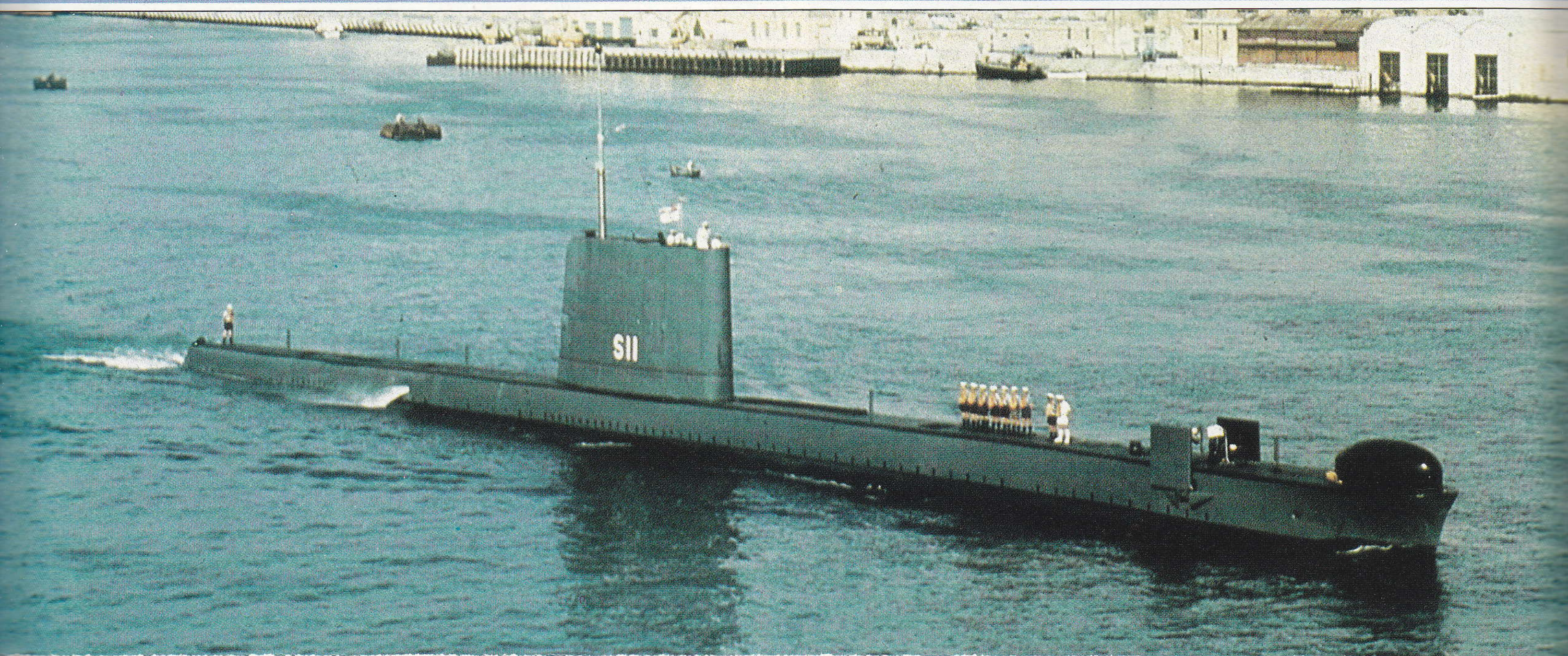
The current strength of the Royal Navy's conventional submarine (SSK) force comprises 13 'Oberon' and two 'Porpoise' class vessels. Of these 15 boats, nine serve with the 1st Submarine Squadron based at HMS Dolphin, Portsmouth, and two with the nuclear attack submarine (SSN) 3rd Submarine Squadron at HMS Neptune, Faslane. The remaining four are either undergoing refit or engaged in specialist trials. Although the demise of the diesel-powered submarine was discussed at certain earlier times by factions within the Ministry of Defence, because of the general enthusiasm generated for nuclear-powered submarines, it rapidly became apparent that these larger and much more expensive craft could not undertake certain roles that an SSK could attempt either with the same safety factor or with reasonable chance of success. Thus the conventional submarine laid superior claim to the conduct of operations within the relatively shallow waters of the continental shelf region, or as the main platform for conducting clandestine operations with special forces, or for missions of a surveillance or reconnaissance nature. The use of the 'Oberon' class boat HMS *Onyx* with Special Boat Service units aboard and for various beach surveys in the Falkland Islands during the 1982 war is a case in point.

The Royal Navy also employs its submarines in the more standard tasks of countering hostile surface shipping (for both sea denial and economic warfare reasons), search and rescue of downed friendly airmen, the laying of small offensive minefields in restricted shipping routes (to block or hinder the passage of high-value surface units or convoys), and as very quiet listening posts at natural 'choke points'. This last allows SSKs to monitor and report the movements of hostile subsurface craft (especially SSNs) so that friendly SSNs can be vectored on to them to trail or, in wartime, sink them. The latter task also opens up the possibility of the conventional boat under certain circumstances being able to 'ambush' the hostile craft with its own weapon systems, although this would alert the enemy to its presence there. The other major peacetime task which takes up a considerable amount of the British units' time is to act as training vessels for both subsurface and surface ASW units. They do this by acting as 'targets' during exercises and by providing experience for personnel in the running and operating of a submarine at sea.

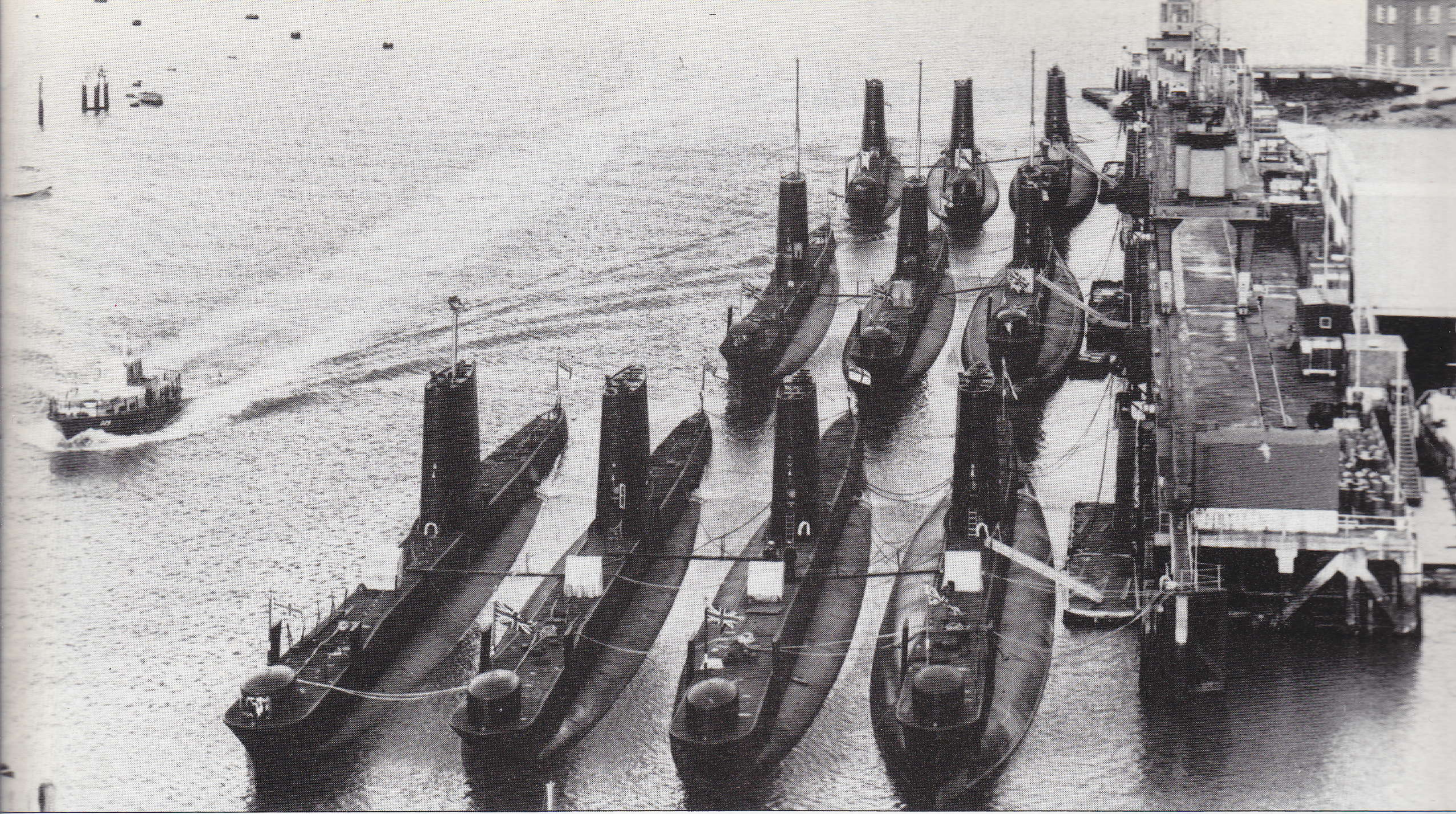
The Perisher

By far the hardest of the service training courses is the Commanding Officer's Qualifying Course (COQC) or, as it is more commonly known, 'the Perisher'. This lasts for five months, during which up to a dozen suitably experienced and qualified submarine officers from the Royal Navy and friendly navies are put through an intensive and very expensive series of mini-exercises designed to test their potential and suitability to command a submarine. Land-based simulators coupled with a maximum of four frigates, helicopters and maritime patrol aircraft are used, and specialist training in minelaying, surveillance/reconnaissance and the delivery of special forces and agents is given. The prize for successfully completing the course for a Royal Navy officer is the command of a submarine or the post of first lieutenant on a nuclear submarine (which must have two qualified command officers at all times). Failure means the certainty of leaving the submarine service and possibly the Royal Navy as well.

On patrol the heart of the 'Oberon' is the control room, which is the area directly beneath the sail structure. Within this are located all the necessary sensor, fire-control, propulsion and diving controls, and the action information systems required to control and fight the submarine in a submerged state. The sonar, communication and radar/ECM systems all have their own little 'shacks' within this area, while the rest share the remaining space available. Because of the difference in speed between the submerged 'Oberon' and any potential target, the skipper has to use his search and attack periscopes more than would his counterpart in a nuclear submarine. This helps him to anticipate what the target is about to do so that he can place his boat in the best available position to engage it. Although he has a torpedo fire-control system with computer to aid him, the skipper still has to assist these calculations by obtaining the course and speed of the target ship through finding its bearing and range via the periscopes. The former is simply the angle from the submarine at which the target is seen, and is read off a 360° scale when the periscope is pointed precisely at the ship. Taking the range is more complicated and requires a split-image device on the periscope to raise a second image of the target above the true image. When the waterline of the raised image is located at the top of the real image's masts the

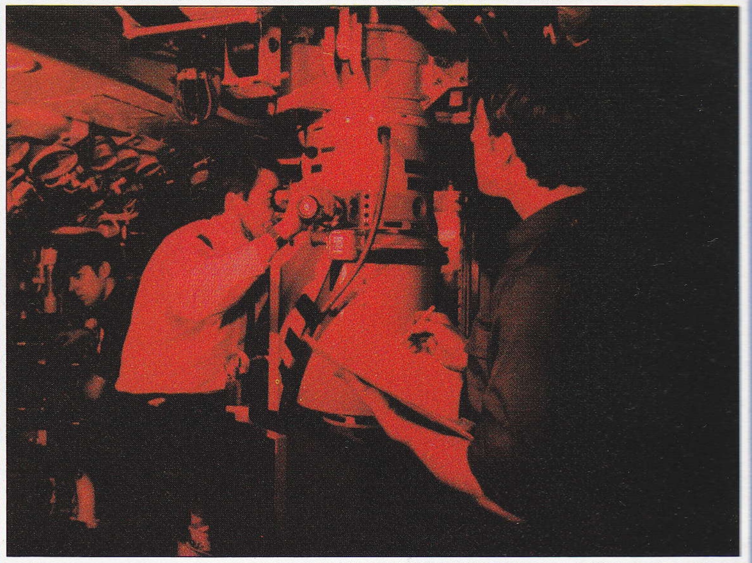


HMS Orpheus *is seen leaving Malta in the days when it was an important Royal Navy base. The boats at Malta were inheritors of a fighting tradition second to none dating from the bitter struggle for control of the Mediterranean during World War II.*



Above: The 1st Submarine Squadron berth at Gosport. The 'Oberons' and the two remaining 'Porpoise' class boats are to be replaced by the newly developed 'Upholder' class, but should remain in service well into the 1990s.

Below: Space is at a premium in the diesel-electric powered boats, unlike their much larger nuclear-powered brethren. A World War II submariner would probably feel at home in this 'Oberon' class control room, red-lit while operating at night.



resulting angle in minutes of arc is read off a scale; an imaginary right-angle triangle is then drawn from which the third unknown angle is deduced, and using the height of the target's masts (which would be accurately known from intelligence data if it is an enemy warship) the length of the triangle's base (the range) in yards can be calculated. By taking precise timings as the ranges are obtained, an accurate measure of the target's speed can be determined. All the data from the sensors and periscope observations are used to prepare a target plot from which the relevant information is fed into the torpedo fire-control computer to work out the firing solution (i.e. the point at which the torpedo launch has the greatest chance of success with the conditions given).

To attack the target the skipper has a choice of two torpedo types. For the simple beam attack and in areas where wire-guided or acoustic-homing torpedoes would be relatively useless, he has the trusty and well proven Mk 8, which began its life back in 1927 and served throughout World War II. Unfortunately, to make a really effective attack with this model the skipper has to close to a point well within its maximum range. The Mk 8 can be fired at offset gyro angles if required, and has two speed settings (44.5 kts or 40 kts) for ranges of 4.54 km (2.82 miles) and 6.36 km (3.95 miles) respectively. Since 1981 the skipper has also had available the Mk 24 Mod 1 Tigerfish dual-role wire-guided torpedo. With a top speed of 35 kts for attack and a slower search speed, the maximum range is in the order of 22 km (13.67 miles). This electrically-powered torpedo was shown recently in a blaze of publicity to be able to sink the ex-'County' class destroyer *Devonshire* by breaking her back. However, what was not made clear was that considerable damage had already been done by a direct hit from a Sea Eagle missile; moreover, it was not revealed what amount of internal damage control features were present. Before this, a series of three Tigerfish firings from nuclear submarines in the South Atlantic under simulated war conditions all missed their target. A further refit of the torpedo is now under way to try to rectify the problems found.

Covert operations

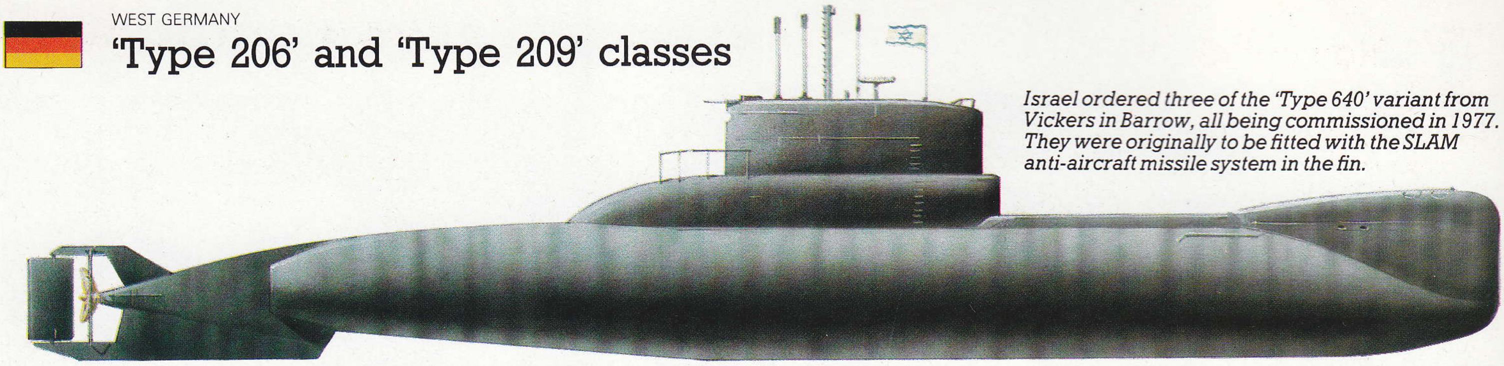
For the covert minelaying mission the forward torpedo compartment is restored with Mk 5 ground mines and Mk 66 buoyant mines. Such operations principally require expert navigation coupled with the skipper's inbuilt ability to remain unobserved. Once in enemy coastal waters he can rely only on his passive sonar systems, depth sounder and the occasional quick periscope look to check for surface ships and to fix his position.

Unless he has a special diver lock-out chamber available, the skipper has to bring his boat temporarily to the surface to unload agents or special-force teams. In the case of the Special Boat Squadron, four-man teams are usually delivered by two-man canoes from several miles off shore. These canoes, together with the men and equipment, are stowed in the forward torpedo compartment between the reloads, and unloaded on the surface via the forward torpedo loading hatch onto the deck, where the SBS unit embarks. As soon as the unloading is finished the submarine dives and the loaded canoes simply float off. They are then tied together with a long length of rope and are positioned with their bows pointing towards the land and well apart. The crews then each shake a rattle device so that the submarine can accurately plot their positions. Once this is established the skipper then gently brings his submerged submarine between them with the periscope raised to snag the rope. He then increases speed slightly and tows the two canoes towards the shore. At a distance of 1.6 km (1 mile) or so from the beach, the skipper lowers his periscope and veers off sharply to let the SBS paddle the rest of the way. The subsequent pick-up is the exact reverse of this procedure. If an agent is involved, the rendezvous may well be at sea with a small boat or at a secluded coastal spot. In this case the overriding consideration is not to be spotted during the approach or withdrawal, since that would not only hazard the submarine but also the agent as well; so everything is carefully planned and done extremely quietly.

Although now showing their ages the 'Oberons' are still able to give good accounts of themselves, and are considered by many still to be the finest conventional submarines operational. For the future there is the new 'Upholder' class or Type 2400, which will eventually take over all the various tasks now undertaken by the 'Oberons', and with the carriage of the Sub-Harpoon anti-ship missile (if money is available) introduce new capabilities.

WEST GERMANY

'Type 206' and 'Type 209' classes



Israel ordered three of the 'Type 640' variant from Vickers in Barrow, all being commissioned in 1977. They were originally to be fitted with the SLAM anti-aircraft missile system in the fin.

Studies began in 1962 by IKL for a follow-on development of the 'Type 205' design. The new **'Type 206' class**, built of high-tensile non-magnetic steel, was to be used for coastal operations and had to conform with treaty limitations on the maximum tonnage allowed to West Germany. New safety devices for the crew were fitted, and the armament fit allowed for the carriage of wire-guided torpedoes. After final design approval had been given, construction planning took place in 1966-8, and the first orders (for an eventual total of 18 units) were placed in the following year. By 1975 all the vessels, ***U13*** to ***U30*** (S192-199 and S170-179), were in service. Since then the class has been given extra armament in the form of two external GRP containers to carry a total of 24 ground mines in addition to their normal torpedo armament. From 1988 onwards 12 of the class are to be modernized with new electronics and torpedoes to form the **'Type 206A' class**.

In the mid-1960s IKL also designed a new class of submarine for the export market that became the **'Type 209' class** in 1967. Designed specifically for the ocean-going role, the 'Type 209' can, because of its relatively short length, operate successfully in coastal waters. The 'Type 209' and its variants have proved so popular that over 40 have been built or ordered to date by a number of foreign navies. Five variations have so far been constructed: the original **54.3-m 'Type 209'** 178.1-ft long version (960 tons surfaced and 1,105 tons dived), the **56-m 'Type 209'** 183.7-ft long versions (980 tons surfaced and 1,185 tons dived), the **59.5-m 'Type 209'** 195.2-ft long version (1,000 tons surfaced and 1,285 tons dived), the 64.4-m (211.3-ft) **'Type 1500'** variant (1,660 tons surfaced and 1,850 tons dived) and the smaller **'Type 640'** 45-m (147.6-ft) long coastal derivative (420 tons surfaced and 600 tons dived). The countries which have bought these vessels are Greece (four 54.3-m and four 56-m 'Type 209s'), Argentina (two 56-m 'Type 209s'), Peru (six 56-m 'Type 209s'), Colombia (two 56-m 'Type 209s'), Turkey (12 56-m 'Type 209s', most of which are being built locally with West German help), Venezuela (two 59.5-m 'Type 209s'), Chile (two 59.5-m 'Type 209s'), Ecuador (two 59.5-m 'Type 209s'), Indonesia (two 59.5-m 'Type 209s' plus a further four projected), Brazil (two 59.5-m 'Type 209s' plus a further one projected), India (four 'Type 1500' plus two more projected) and Israel (three 'Type 640' plus three larger units projected). Each country can choose its own equipment fit and crew complement level according to the amount of money it is willing to spend.

During the 1982 Falklands war the Argentine Type 209 submarine *San Luis* made three unsuccessful torpedo attacks on vessels of the British task force, but because of her presence tied up considerable British ship and aircraft resources in trying to find her.

The Greek navy 'Type 209' **Amphitrite** *(S117) was part of the second batch of four procured. The first batch was the first export order placed for the design, and they were delivered in the period 1971-2, with the second group following in 1979-80 (built to the larger 56-m/183.7-ft length).*

Specification
'Type 206' class

Displacement: 450 tons surfaced and 500 tons dived

Dimensions: length 48.6 m (159.4 ft); beam 4.6 m (15.1 ft); draught 4.5 m (14.8 ft)

Propulsion: two diesels delivering 895 kW (1,200 hp) with one electric motor driving one shaft

Speed: 10 kts surfaced and 17 kts dived

Diving depth: 150 m (492 ft) operational and 250 m (820 ft) maximum

Torpedo tubes: eight 533-mm (21-in) bow

Basic load: eight 533-mm (21-in) anti-submarine or anti-ship wire-guided torpedoes, or 16 influence ground mines, plus another 24 mines in external containers

Electronics: one Calypso surface-search radar, one low-frequency bow sonar, one high-frequency attack sonar, one WM-8 torpedo fire-control/action information system, and one ESM system

Complement: 22

Specification
56-m 'Type 209' class

Displacement: 980 tons surfaced and 1,185 tons dived

Dimensions: length 56.0 m (183.7 ft); beam 6.2 m (20.3 ft); draught 5.5 m (18.0 ft)

Propulsion: four diesels delivering 1790 kW (2,400 hp) with one electric motor driving one shaft

Speed: 10 kts surfaced and 22 kts dived

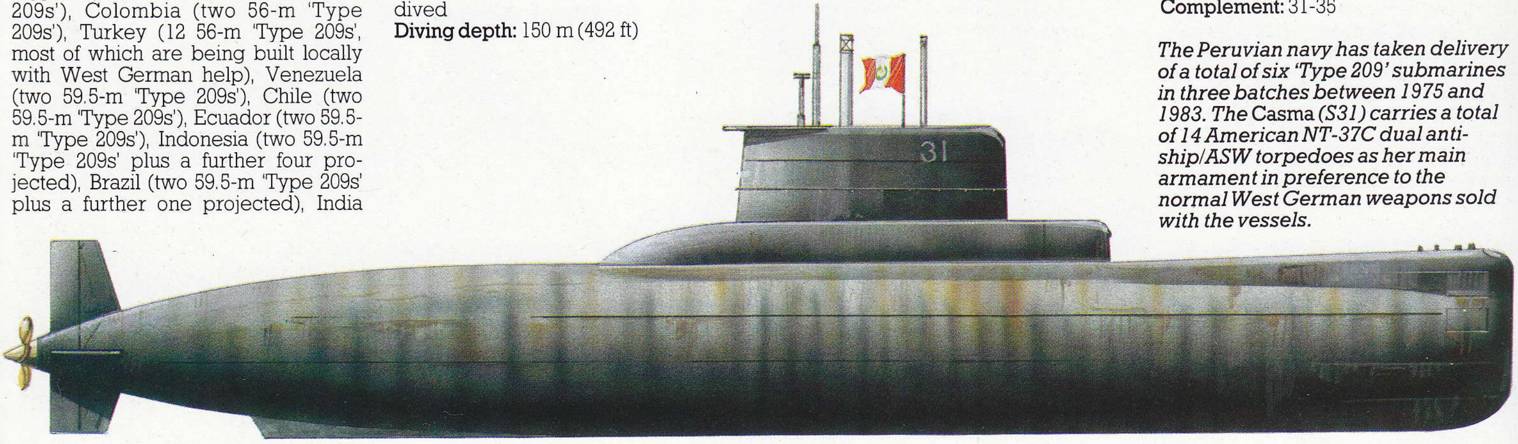
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum

Torpedo tubes: eight 533-mm (21-in) bow

Basic load: 14 533-mm (21-in) anti-submarine and anti-ship wire-guided torpedoes, or 28 influence ground mines

Electronics: one surface-search radar, one low-frequency bow sonar, one passive intercept sonar, one torpedo fire-control/action information system, and one ESM system

Complement: 31-35



The Peruvian navy has taken delivery of a total of six 'Type 209' submarines in three batches between 1975 and 1983. The **Casma** *(S31) carries a total of 14 American NT-37C dual anti-ship/ASW torpedoes as her main armament in preference to the normal West German weapons sold with the vessels.*

CHINA

'Romeo' class

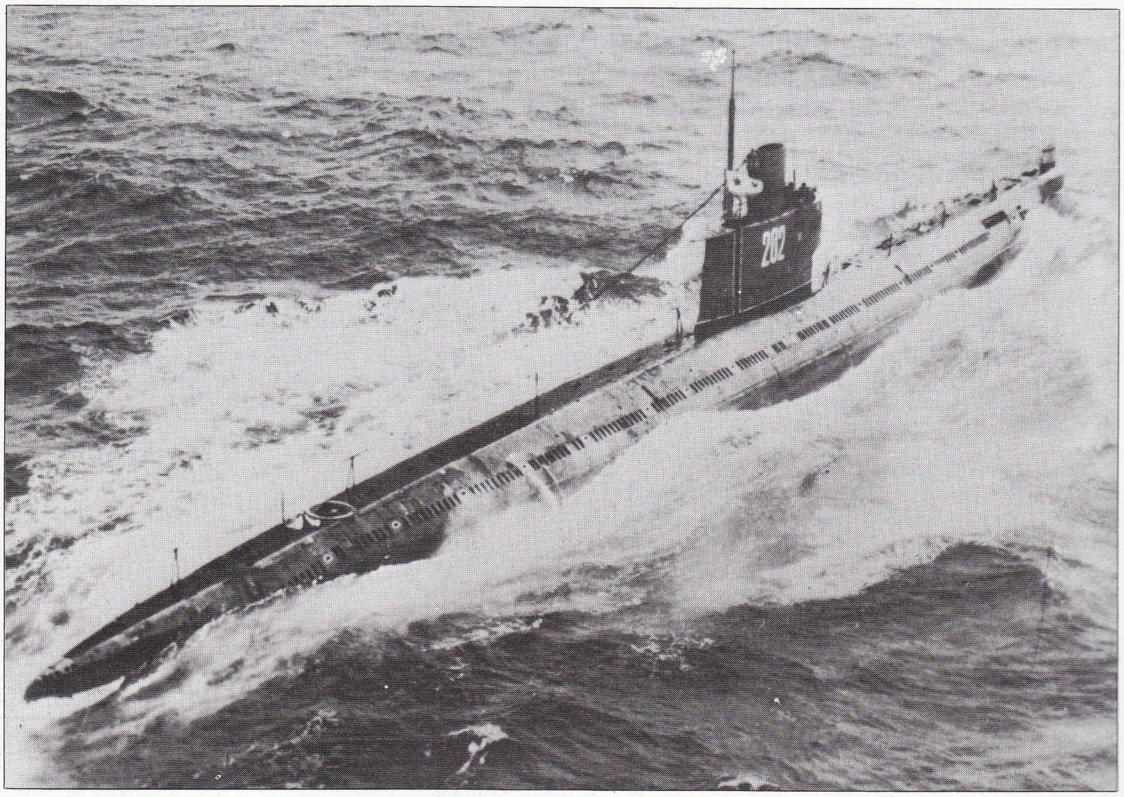
Although it was the Soviets who built the first **'Romeo' class** submarines in 1958 at Gorky,as an improvement on their 'Whiskey' design, the construction coincided with the successful introduction of nuclear propulsion into Soviet submarines, so only 20 were actually completed out of the 560 boats originally planned.

However, the design was passed to the Chinese as part of the development of their weapons production industry, and the class has been built in China since 1964, the first boats being completed at the Wuzhang shipyard under the local designation **'Type 033'**. Three further shipyards, located at Guangzhou (Canton), Jiangnan (Shanghai) and Huludao, then joined the programme to give a maximum yearly production rate of nine units during the early 1970s. This rate has now been reduced to two vessels per year. A total of 98 'Romeos' has been constructed to date for the Chinese navy, while a further 10 have been exported to Egypt (six) and North Korea (four, with another 11 built locally with Chinese assistance).

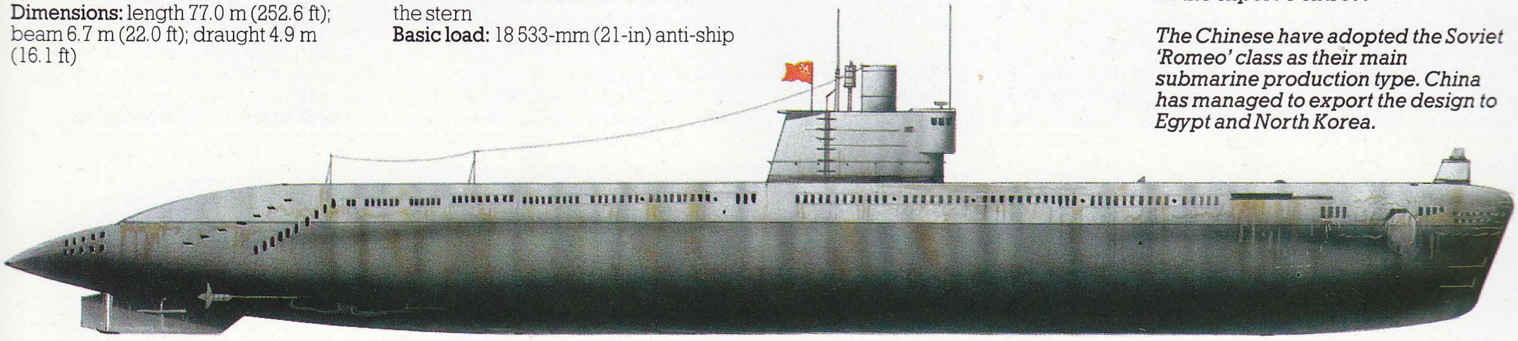
Of the original Soviet boats only 10 remain operational with the Soviet navy. Six were transferred to the Egyptians in 1966-8, two to Bulgaria in the early 1970s and two were loaned to Algeria in 1982-3 for a five-year period as training boats, before Algeria's acquisition of more modern submarines. In physical appearance both the Chinese and Soviet 'Romeos' are essentially identical except that the Soviet boats tend to have extra sonar installations around the bow.

Specification

'Romeo' class
Displacement: 1,330 tons surfaced and 1,700 tons dived
Dimensions: length 77.0 m (252.6 ft); beam 6.7 m (22.0 ft); draught 4.9 m (16.1 ft)
Propulsion: two diesels delivering 2983 kW (4,000 hp) with two electric motors driving two shafts
Speed: 6 kts surfaced and 13 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: eight 533-mm (21-in) located as six in the bows and two at the stern
Basic load: 18 533-mm (21-in) anti-ship or anti-submarine torpedoes, or 36 AMD-1000 influence ground mines
Electronics: one 'Snoop Plate' surface-search radar, one medium-frequency Feniks bow sonar, one high-frequency Herkules bow sonar, and one 'Stop Light' ECM system
Complement: 60



With only a few 'Romeo' class units left in service, the Soviet navy has transferred six to Egypt, two to Bulgaria and two to Algeria. The latter are on loan and are being used to train Algerian naval personnel in submarine operations prior to transfer of more modern units such as the export 'Foxtrot'.



The Chinese have adopted the Soviet 'Romeo' class as their main submarine production type. China has managed to export the design to Egypt and North Korea.

USSR

'Foxtrot' class

Built in the periods 1958-68 (45 units) and 1971-4 (17 units) at Sudomekh for the Soviet Union, the **'Foxtrot' class** is still in production at a slow rate for export. The class has proved to be the most successful of the post-war Soviet conventional submarine designs, a total of 62 entering service with the Soviet navy. Two were subsequently struck off as a result of damage sustained in accidents, one of them apparently caused by a collision with the Italian liner *Angelino Lauro* in the Bay of Naples on 10 January 1970, after which the unit was seen later at a Soviet naval anchorage off Morocco with 8 m (26.2 ft) of its bow missing. All four Soviet navy fleet areas operate 'Foxtrots', and the Mediterranean and Indian Ocean squadrons regularly have units attached to them as part of their subsurface forces.

The first foreign recipient of the type was India, which took eight brand new boats between 1968 and 1975. India was followed by Libya (with six units received between 1976 and 1983) and by Cuba (three boats handed over between 1979 and 1984). These differ from the standard Soviet units only in having export-grade electronic and weapon fits, although the Indian navy units are very close to the Soviet vessels.

Like all Soviet conventional and nuclear submarine classes, the 'Foxtrots' are fitted to carry the standard Soviet 15-kiloton yield anti-ship torpedo as part of its weapons load, but no liners for 400-mm (15.7-in) ASW torpedoes have apparently not been fitted (contrary to several reports). The Soviet 'Foxtrots' were built in three distinct subclasses that differ only in the propulsion plant. The last group is thought to have served as prototypes for the follow-on 'Tango' design. The submerged non-snorkelling endurance of the class is estimated at around 5 to 7 days at very low (2-3 kts) speeds.

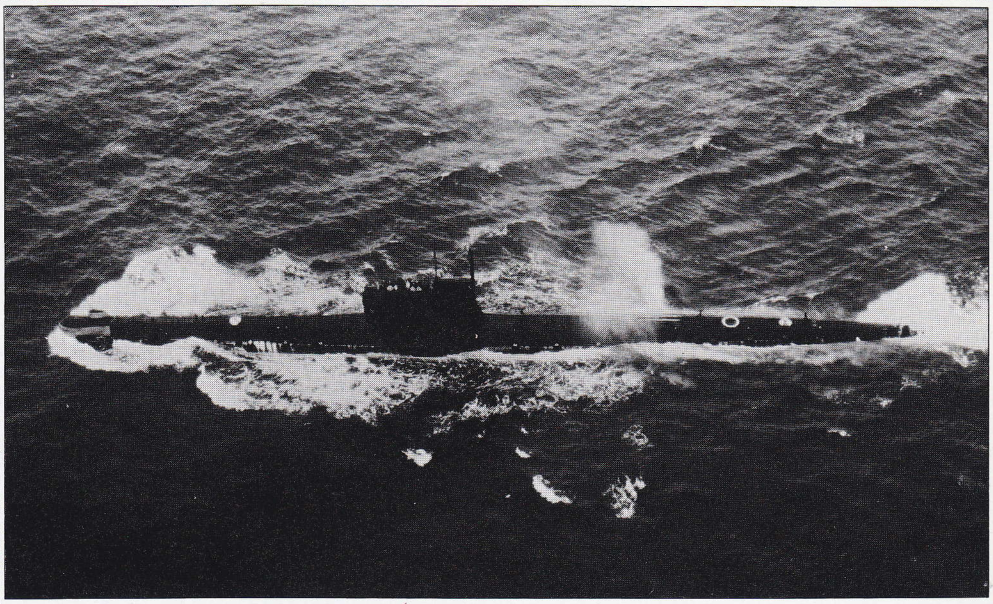
Specification

'Foxtrot' class
Displacement: 1,950 tons surfaced and 2,500 tons dived
Dimensions: length 91.5 m (300.2 ft); beam 8.0 m (26.25 ft); draught 6.1 m (20.0 ft)
Propulsion: three diesels delivering 4474 kW (6,000 hp) with three electric motors driving three shafts
Speed: 18 kts surfaced and 16 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: 10 533-mm (21-in) located as six at the bows and four at the stern
Basic load: 22 533-mm (21-in) anti-ship and anti-submarine torpedoes, or 44 AMD-1000 influence ground mines
Electronics: one 'Snoop Tray' surface-search radar, one medium-frequency Feniks sonar, one high-frequency Herkules sonar, one torpedo fire-control/action information system, and one 'Stop Light' ECM system
Complement: 80

'Foxtrot' in Action

Together with the British 'Oberon' class, the Soviet 'Foxtrot' conventionally-powered submarines have probably been the most successful design of the post-war years. Still effective almost 30 years after its first introduction, the 'Foxtrot' is only now being surpassed by more modern designs.

Below: The regular 'Foxtrot' deployments to the Indian Ocean theatre have now been taken over by the more modern 'Kilo' class, but they can still provide an effective attack force when facing the less well ASW-armed navies such as China in the Far East.



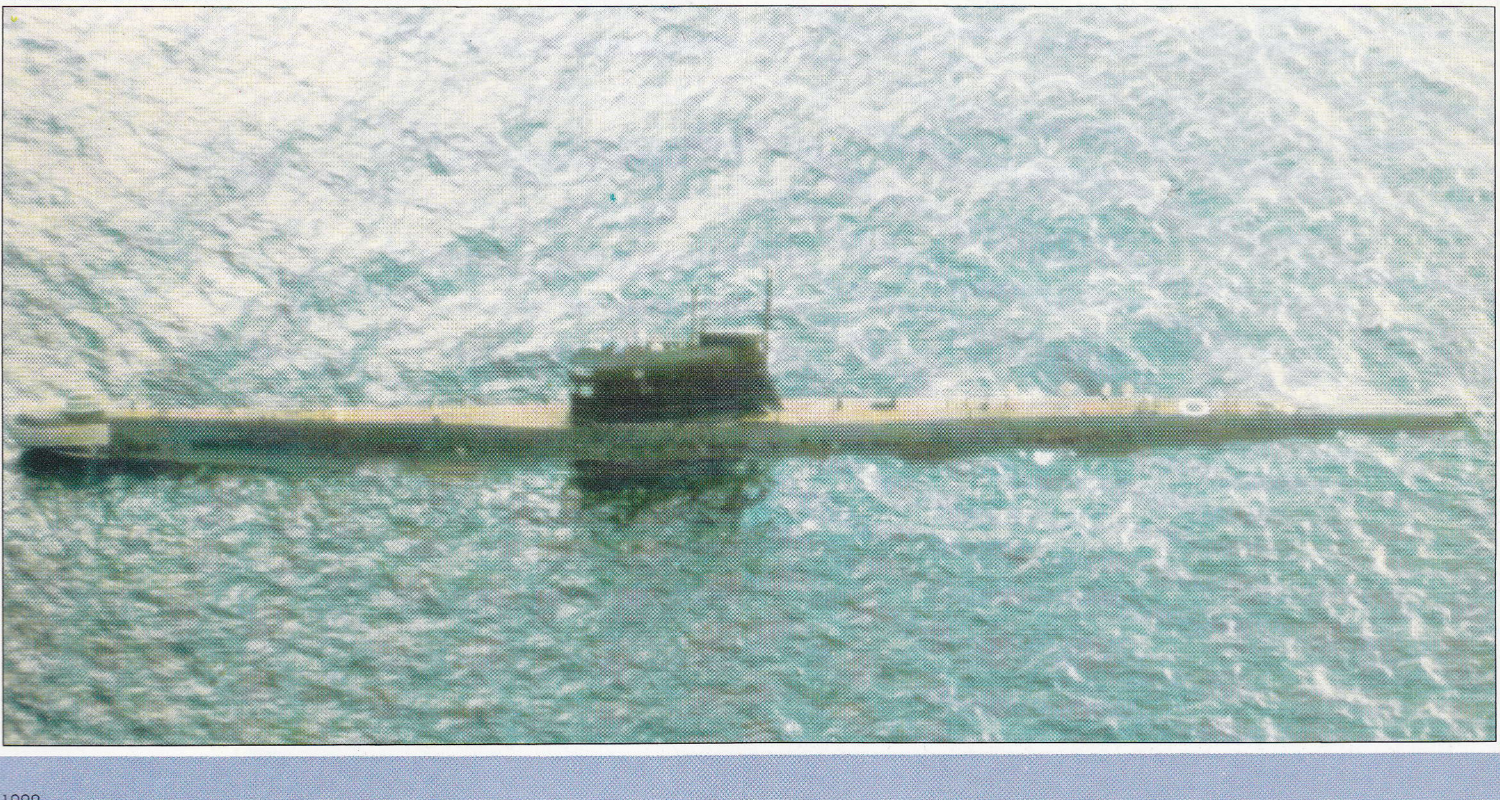
Since 1958, when it first entered service with the Soviet navy, the 'Foxtrot' class has proved to be the most successful of the Soviet post-war conventional submarine designs. In technical terms the 'Foxtrot' was a development of the earlier 'Zulu' class long-range ocean-going type with a more streamlined sail and a sensor outfit similar to that fitted to the contemporary medium-range 'Romeo' class. The large conformal medium-frequency Feniks passive detection sonar was housed in a large rubber-covered bulbous extension to the bow with the smaller active high-frequency scanning Herkules attack sonar fitted into a rubber-sheathed elliptical radome atop it. A further cone-shaped sonar installation, similar in appearance to a 'fez', is often fitted to the top of the Herkules radome. The exact purpose of this protrusion is not readily apparent, although it has been suggested that it is an underwater telephone system.

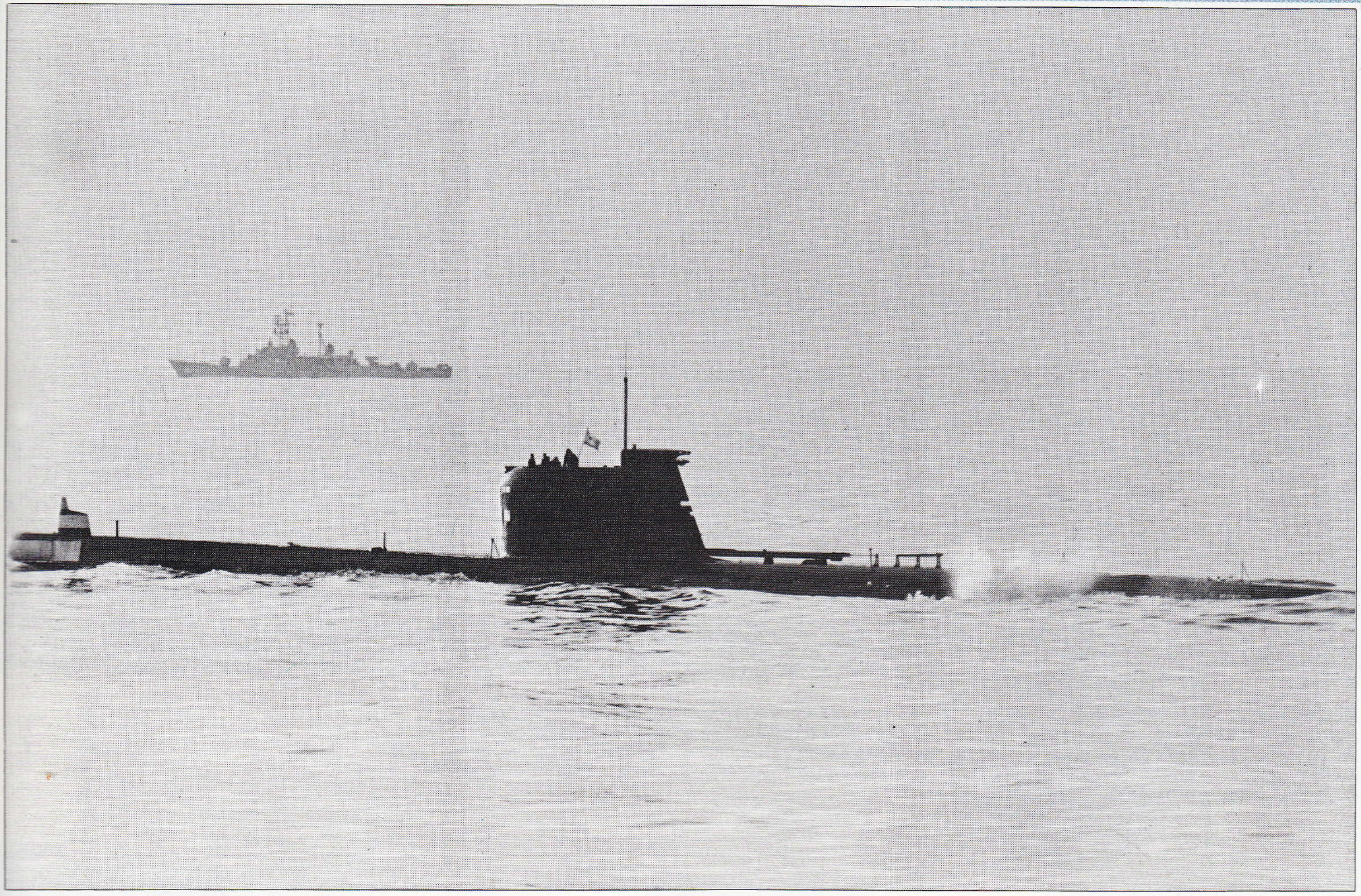
A more plausible explanation, however, is that because of its size and location it is probably a close-range active sonar for collision avoidance and minefield detection purposes. There is a fourth sonar system, which comprises four 1-m^2 (10.76-sq ft) plates located around the middle region of the forward edge of the sail. This is believed to be a passive system for the interception of active sonar transmissions from enemy surface or subsurface units. To complement these subsurface sensors the boat also has a retractable mast-mounted 'Stop Light' ECM system and a 'Snoop Tray' high-definition surface and air-search radar. The latter, like most submarine radars, operates on the I-band frequency since nearly all the commercial navigation radars available use this frequency; when it operates its signals are thus extremely difficult to distinguish from those emanating from merchant ships, especially when the submarine is in the vicinity of a major shipping lane. For locating the origin of radio signals the 'Foxtrot' also carries a direction-finding 'Quad Loop' antenna.

Three subgroups

During the construction period of the 'Foxtrot' for the Soviet navy three distinct subgroups were produced, these differing from each other only in the propulsion plant fitted. The first subgroup had the same three-shaft diesel-electric plant as the 'Zulu' class, while the second group may have been fitted with a newer model of diesel than that of the first group. The final group is thought to have acted as the propulsion test-beds for the follow-on 'Tango' design, and may have tried additional silencing features to ensure that the new sub-

The 'Foxtrot' class is used all over the North Atlantic by the Soviet Northern Fleet, as shown by this 'Foxtrot' at anchor in the Gulf of Mexico, some 80 nautical miles west of the American port of Key West, Florida.





The Northern Fleet supplies all the submarines that are deployed with the Soviet Mediterranean squadron; at any one time there are six to eight 'Foxtrots' and one or two 'Tangos' there. This 'Foxtrot' is being shadowed by the USS Jonas Ingram *(DD938) in the early 1970s.*

marine class obtained even better performances from the nuclear submarine low-frequency sonar systems that the class carries. The maximum underwater speed of the 'Foxtrot' is 16 kts, although the boat rarely attains this except in escape and evasion manoeuvres as it rapidly depletes the batteries. Full snorkeling facilities are fitted, with the intake and exhaust outlets mounted in the rear 'bird-lip' section of the sail to allow recharging of the two batteries while running submerged just below the surface. The standard submarine search and attack periscopes are carried, together with their associated photographic reconnaissance equipment.

Armament fit

The armament is the same as was fitted to the 'Zulu' class, with six bow 533-mm (21-in) torpedo tubes and four 533-mm stern tubes. The bow tubes have a torpedo compartment to allow servicing of the weapons and stowage of 12 reloads, while the aft tubes have no such facilities. For the minelaying role the Soviets tend to replace each of the forward torpedoes with two AMD-1000 influence-activated ground mines, while retaining the aft torpedoes for self-defence. The range of the 'Foxtrot' allows it to operate in the covert minelaying role in all European waters and along the most important parts of the American continental coastlines. Such an activity is well within the Soviets' capacity as they are the world's leading exponents of offensive mine warfare.

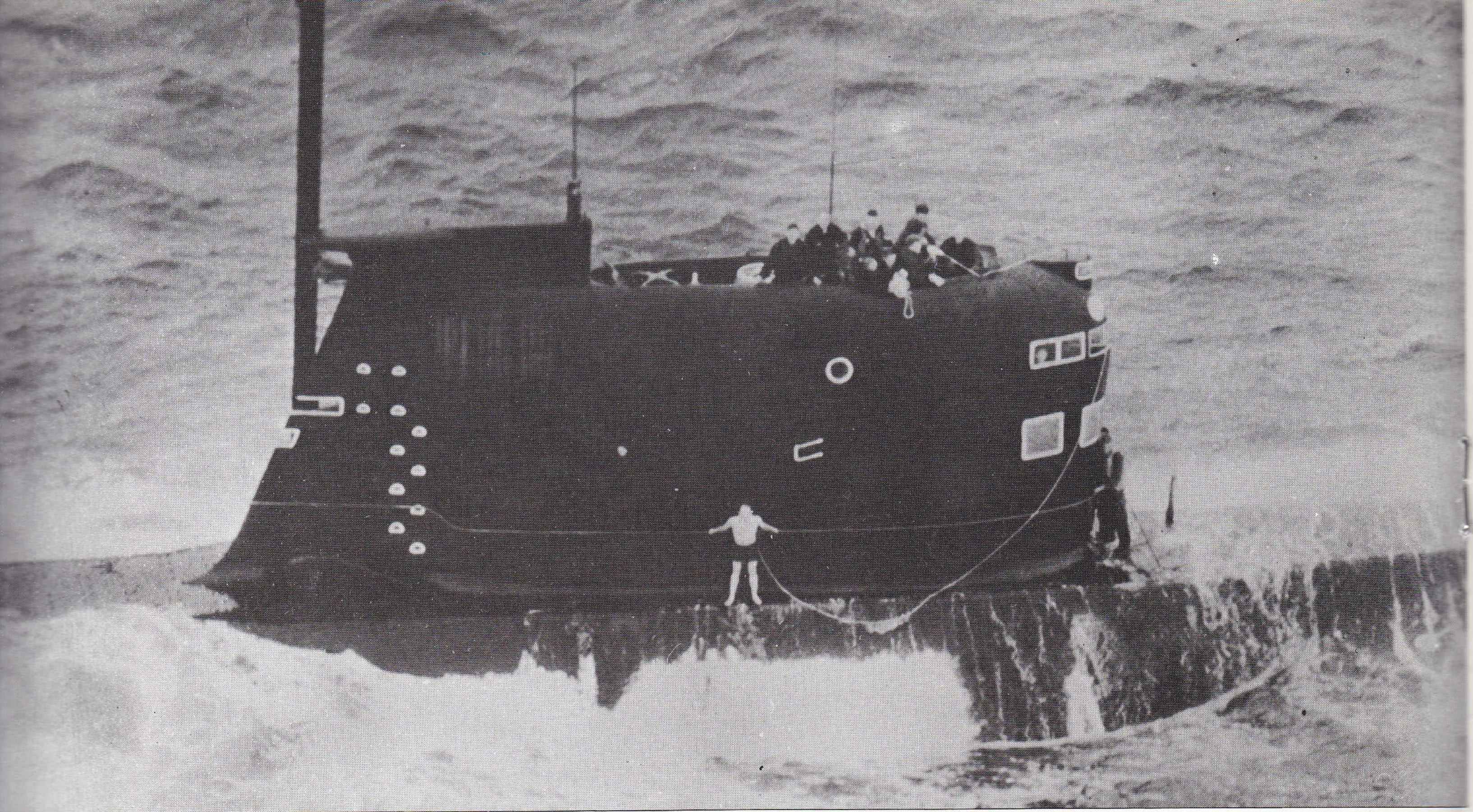
The presence of export versions of the 'Foxtrot' in Cuban and Libyan naval service (with Soviet 'advisers' aboard) ensures that a potential economic warfare threat is never far away from the sea lines of communication of key interest to the West. They also provide a valuable covert method of supplying weapons and other equipment to guerrilla forces friendly to the Warsaw Pact in the regions where the Libyan and Cuban navies operate.

In wartime the Soviet units would also become nuclear capable weapons platforms since they are fitted to carry and fire the standard Soviet 15-kiloton yield nuclear-warhead anti-ship torpedo from the bow tubes. This capability is not matched by any Western navy, and could allow the 'Foxtrot' to sink an aircraft-carrier with a single shot or destroy a fair-sized port or naval base. Of the 22 torpedoes carried, up to four can be nuclear armed, the remainder being either straight-running or acoustic-homing ASW and anti-ship HE-warhead weapons. There is no evidence to suggest as some sources do that any 406-mm (16-in) torpedo tubes are or have ever been fitted aft in the 'Foxtrot' class, since reliable reports from the Indian navy confirm that Indian and Soviet units are fitted with the larger 533-mm weapons. With a submerged endurance of nearly a week at very low speeds before needing to recharge its batteries, the 'Foxtrot' can undertake patrol durations of up to 70 days before its supplies and diesel fuel run out.

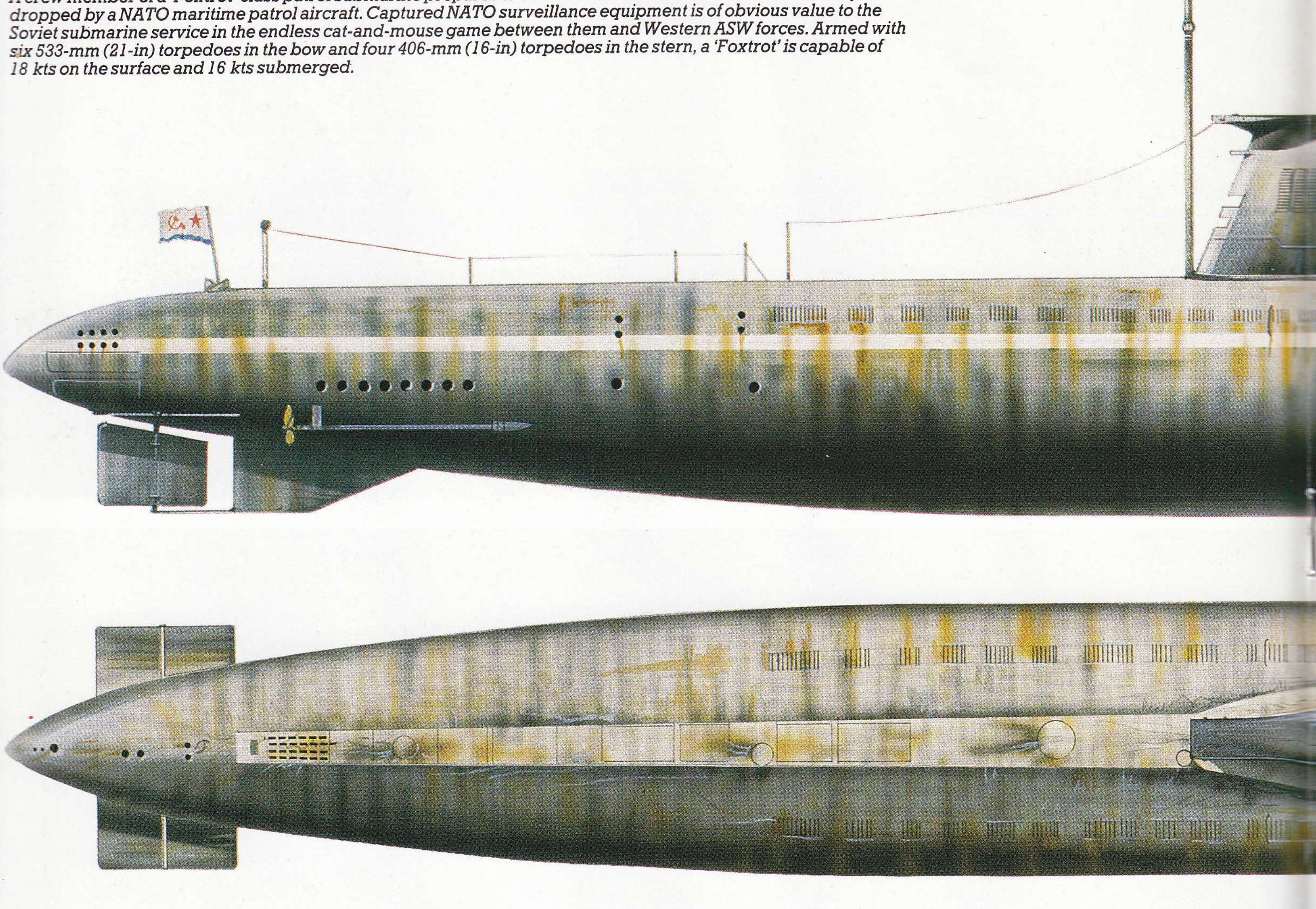
Spetsnaz transport

One role in which the 'Foxtrot' is known to be used at irregular intervals is in the transportation of groups of naval Spetsnaz combat swimmers and their equipment for covert reconnaissance missions and, in wartime, sabotage tasks against foreign naval bases and ports. It is possible that several of the Swedish sightings of Soviet submarines may have been of 'Foxtrots' performing such missions for training purposes. The 'Foxtrot' is particularly suited for this work because of its very quiet operating mode when running silent, and it is possible that several units of the class have now been converted to carry special diver lock-out chambers for covert operations, replacing a small number of obsolete 'Whiskey' class submarines that were known to have been used in this manner in the 1950s and 1960s.

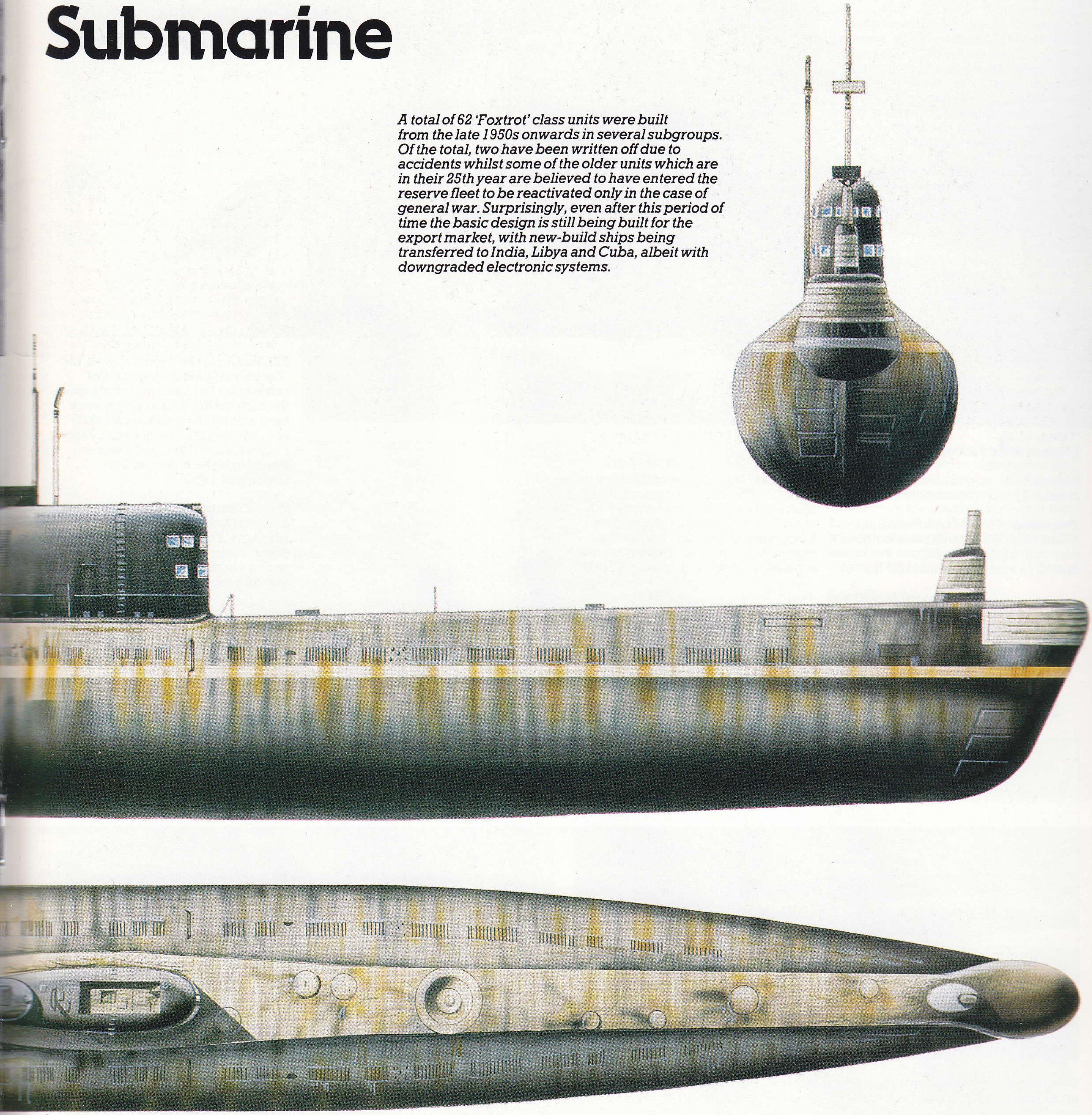
The 'Foxtrot' class is due to remain in service into the 1990s with the Soviet navy, although the earliest units are now starting to enter the reserve fleet because of their age. The fact that the class still remains in slow series production for export 27 years after the first unit was produced testifies to the high regard in which the class is held by the Soviets. This view is echoed by many Western nations, who still consider the class a major threat in the ASW environment of the 1980s. The Royal Navy holds it in some esteem as the 'Foxtrot' is the contemporary of its own 'Oberon' class, which itself is still considered amongst the best of its type available.



A crew member of a 'Foxtrot' class patrol submarine prepares to dive into the Atlantic to retrieve a sonobuoy dropped by a NATO maritime patrol aircraft. Captured NATO surveillance equipment is of obvious value to the Soviet submarine service in the endless cat-and-mouse game between them and Western ASW forces. Armed with six 533-mm (21-in) torpedoes in the bow and four 406-mm (16-in) torpedoes in the stern, a 'Foxtrot' is capable of 18 kts on the surface and 16 kts submerged.



'Foxtrot' Class Diesel-Electric Patrol Submarine

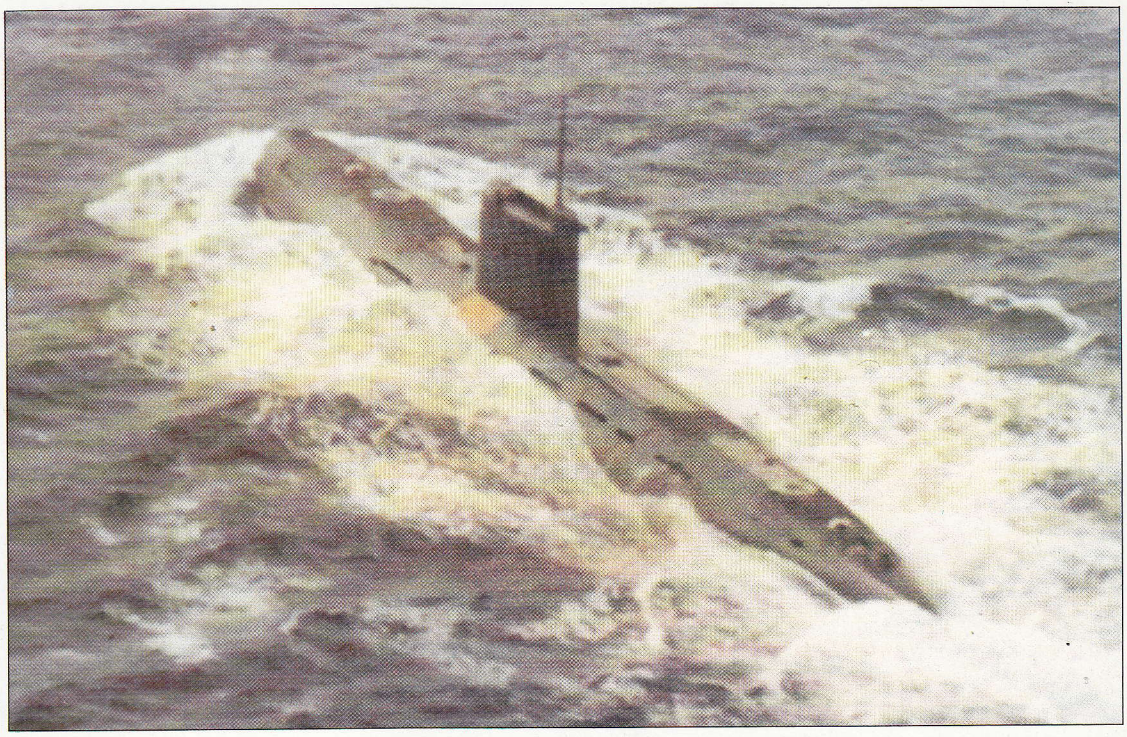


A total of 62 'Foxtrot' class units were built from the late 1950s onwards in several subgroups. Of the total, two have been written off due to accidents whilst some of the older units which are in their 25th year are believed to have entered the reserve fleet to be reactivated only in the case of general war. Surprisingly, even after this period of time the basic design is still being built for the export market, with new-build ships being transferred to India, Libya and Cuba, albeit with downgraded electronic systems.

USSR

'Tango' class

Built as the Soviet navy's interim long-range successor to the 'Foxtrot' class in the Black Sea and Northern Fleet areas, the first unit of the **'Tango' class** was completed at Gorky in 1972. Since then a total of 18 have been constructed in two slightly different versions, the later type being several metres longer than the first in order to accommodate the fire-control systems necessary for launching the torpedo tube-launched SS-N-15, the Soviet equivalent of the American Subroc underwater-launched ASW missile with a nuclear warhead. The bow sonar installations appear to be the same as those fitted to the latter classes of contemporary Soviet nuclear attack submarines, while the propulsion plant is almost certainly the same as was tested on the last subgroup of the 'Foxtrot' design. The battery capacity is said to be much higher than in any preceding Soviet conventional submarine class as a result of the increased pressure hull volume, this allowing an underwater endurance in excess of a week before snorkelling is required. Coupled with the new armament and sensor fit, this would appear to make the 'Tangos' ideal for use in 'ambush' operations against Western nuclear submarines at natural 'chokepoints'. Present indications are that the construction of the class has stopped, possibly suggesting that the definitive successor to the 'Foxtrots' is now ready for volume production.



Evolved from the 'Foxtrot' class, the 'Tango' class long-range patrol submarine has been in service since the early 1970s. The example seen here was photographed off the US coast during the Soviet navy's 24th deployment to the Caribbean, in transit to Havana during late December 1984.

Specification

'Tango' class

Displacement: 3,000 tons surfaced and 3,700 tons dived

Dimensions: length 92.0 m (301.8 ft); beam 9.0 m (29.5 ft); draught 7.0 m (23.0 ft)

Propulsion: three diesels delivering 4474 kW (6,000 hp) with two electric motors driving two shafts

Speed: 16 kts surfaced and 15.5 kts dived

Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum

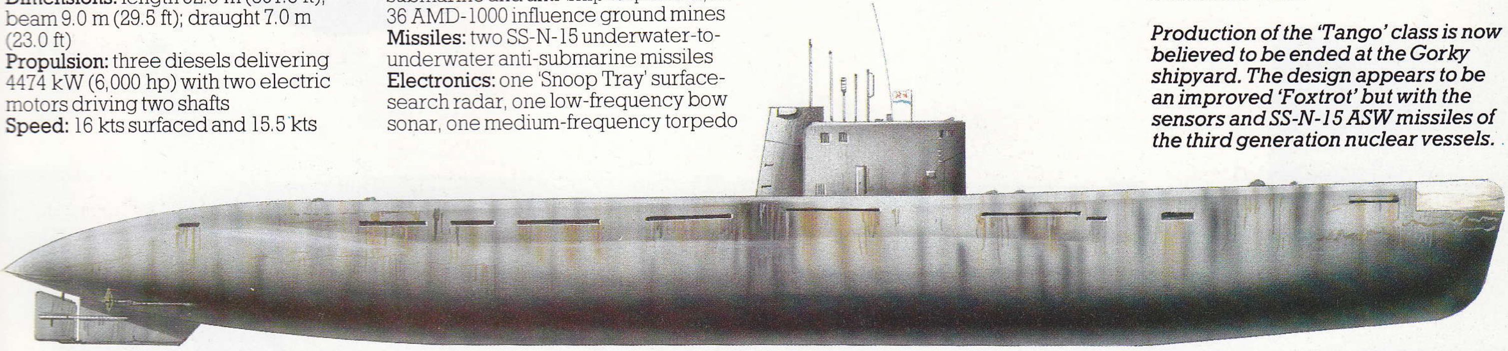
Torpedo tubes: eight 533-mm (21-in) located as six in the bows and two at the stern

Basic load: 18 533-mm (21-in) anti-submarine and anti-ship torpedoes, or 36 AMD-1000 influence ground mines

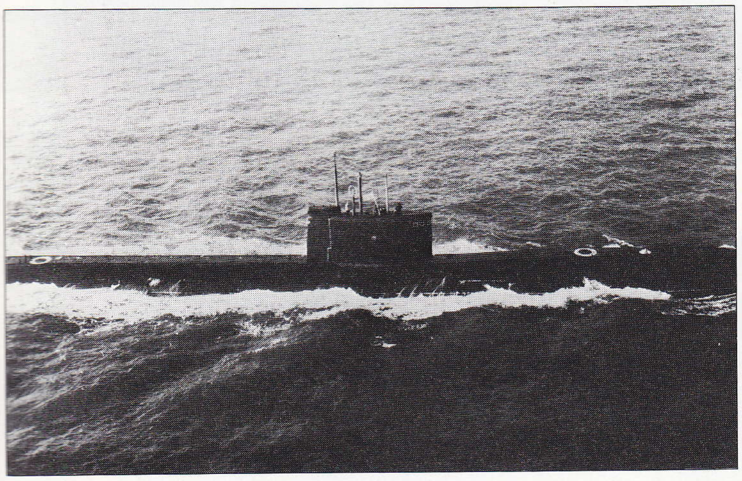
Missiles: two SS-N-15 underwater-to-underwater anti-submarine missiles

Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency torpedo and missile fire-control sonar, one torpedo fire-control/action information system, and one 'Brick Group' ESM system

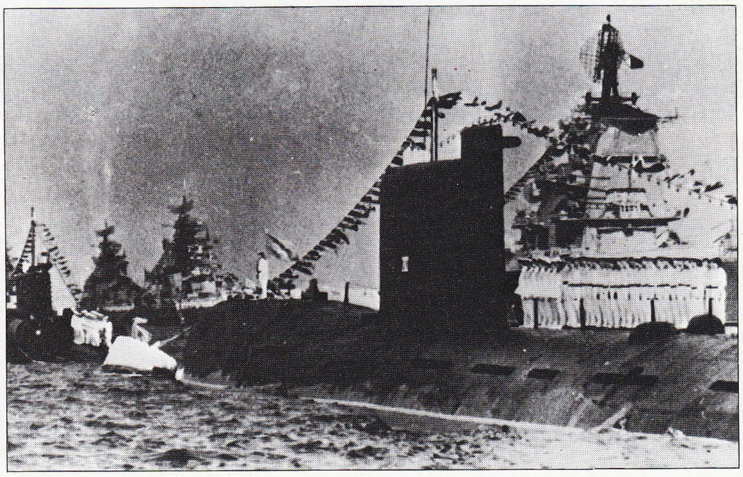
Complement: 60



Production of the 'Tango' class is now believed to be ended at the Gorky shipyard. The design appears to be an improved 'Foxtrot' but with the sensors and SS-N-15 ASW missiles of the third generation nuclear vessels.



The later 'Tango' class units were apparently built to a slightly longer length in order to accommodate all the systems associated with the ASW missile fire-control and targetting functions.

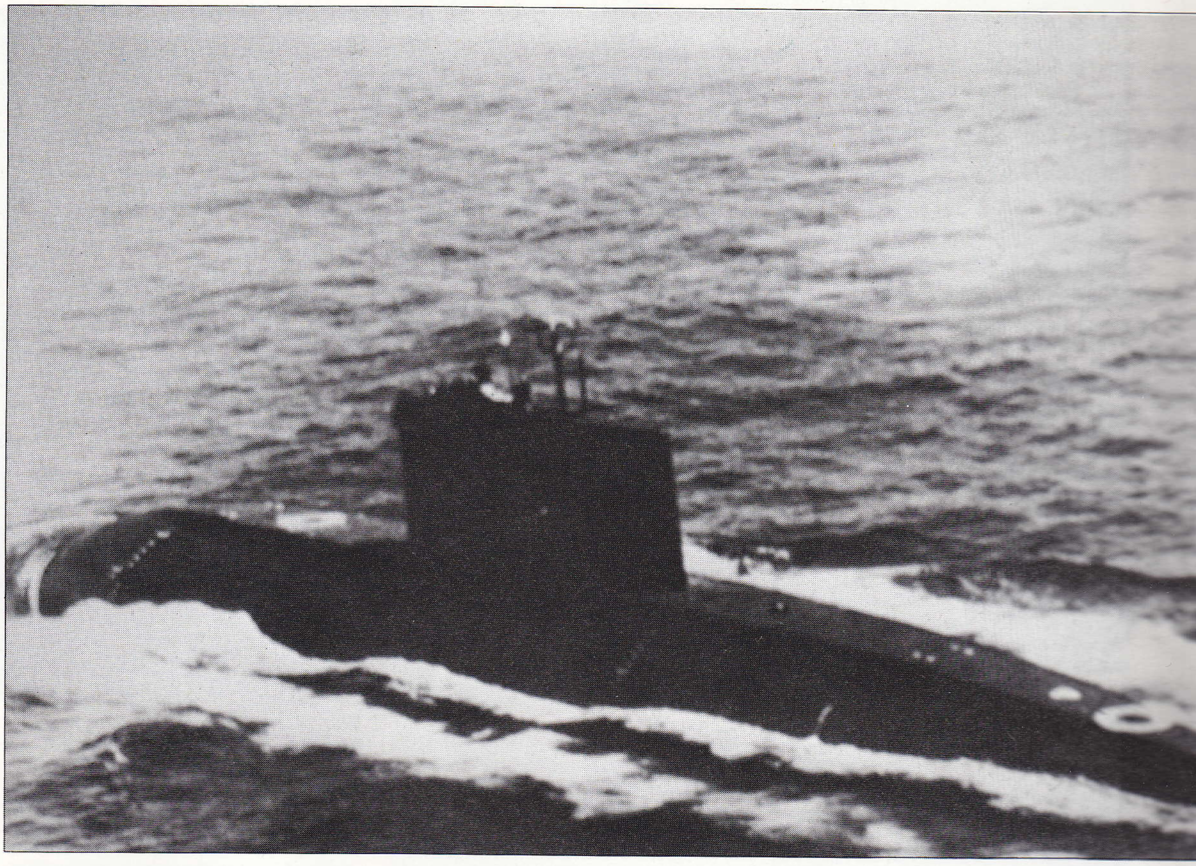


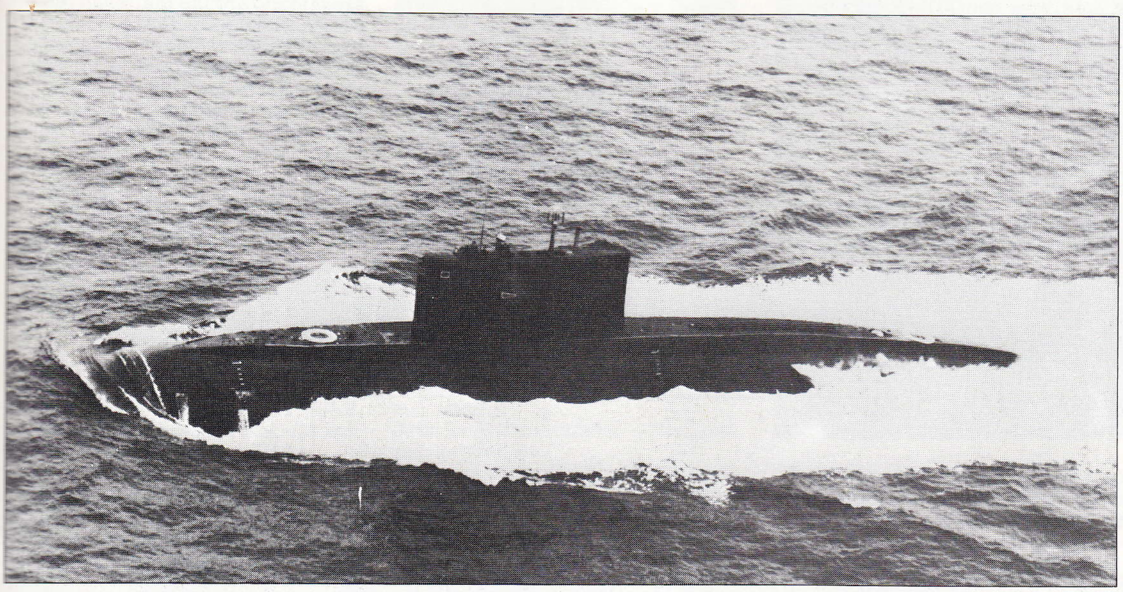
First seen at the July 1973 Sevastopol Naval Review in the Black Sea was the 'Tango' class prototype with the characteristic raised forecasing hump. The submarine to the front of the 'Tango' in the line is a 'Whiskey Twin Cylinder' cruise missile boat, which is used for training.

USSR

'Kilo' class

The **'Kilo' class** submarines are the probable replacements for the 'Whiskey' class units in the Soviet Pacific Fleet, and as such are classed as medium-range vessels. Built at the river shipyard of Komsomolsk in the Soviet Far East, the first unit was launched in early 1980. At least a further five were in service by late 1984 with production believed to have been stepped up to two units per year. The shorter hull form, more advanced than the other contemporary Soviet conventional submarine designs, is more typical of Western teardrop-shaped designs, but is well suited to the enclosed waters off the Soviet Pacific coastlines and islands. In August 1983 the first operational 'Kilo' went to the vast Vietnamese naval base at Cam Ranh Bay for the testing of its weapons systems under tropical conditions, and in the following year the first sighting of a 'Kilo' in the Indian Ocean was disclosed by the Royal Australian Navy: the presence of the 'Kilo' class in that area is thought to be due to the replacement of the normal pair of 'Foxtrot' class submarines as an operational necessity, the new boats having far more sophisticated sonar systems. The armament is said to include some items of specialized minelaying equipment, possibly for the Soviet 'rising mine' weapons. The new low-frequency sonar is situated in the front of the bow above the six 533-mm (21-in) bow torpedo tubes. A probable class total of between 24 and 30 units is expected by the mid-1990s.





Medium-range boats, the 'Kilo' class have been entering service with the Soviet Pacific Fleet since 1980. This boat was seen in transit to the Indian Ocean from the important Soviet base at Cam Ranh Bay in Vietnam, where it is thought to have replaced one of two much less capable 'Foxtrot' class boats.

Specification

'Kilo' class

Displacement: 2,500 tons surfaced and 3,200 tons dived

Dimensions: length 67.0 m (219.8 ft); beam 9.0 m (29.5 ft); draught 7.0 m (23.0 ft)

Propulsion: four diesels with two electric motors driving two shafts

Speed: 15 kts surfaced and 24 kts dived

Diving depth: 450 m (1,476 ft) and 650 m (2,133 ft) maximum

Torpedo tubes: six 533-mm (21-in) bow

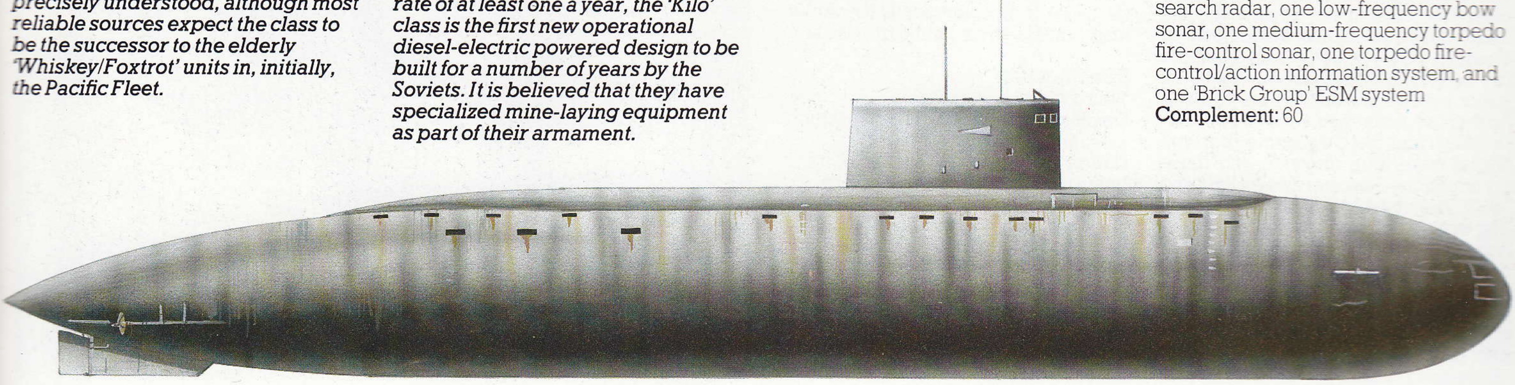
Basic load: 18 533-mm (21-in) anti-submarine and anti-ship torpedoes, or 36 AMD-1000 influence ground mines, or a small number of 'rising mines'

Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency torpedo fire-control sonar, one torpedo fire-control/action information system, and one 'Brick Group' ESM system

Complement: 60

Above: The 'Kilo' class is not precisely understood, although most reliable sources expect the class to be the successor to the elderly 'Whiskey/Foxtrot' units in, initially, the Pacific Fleet.

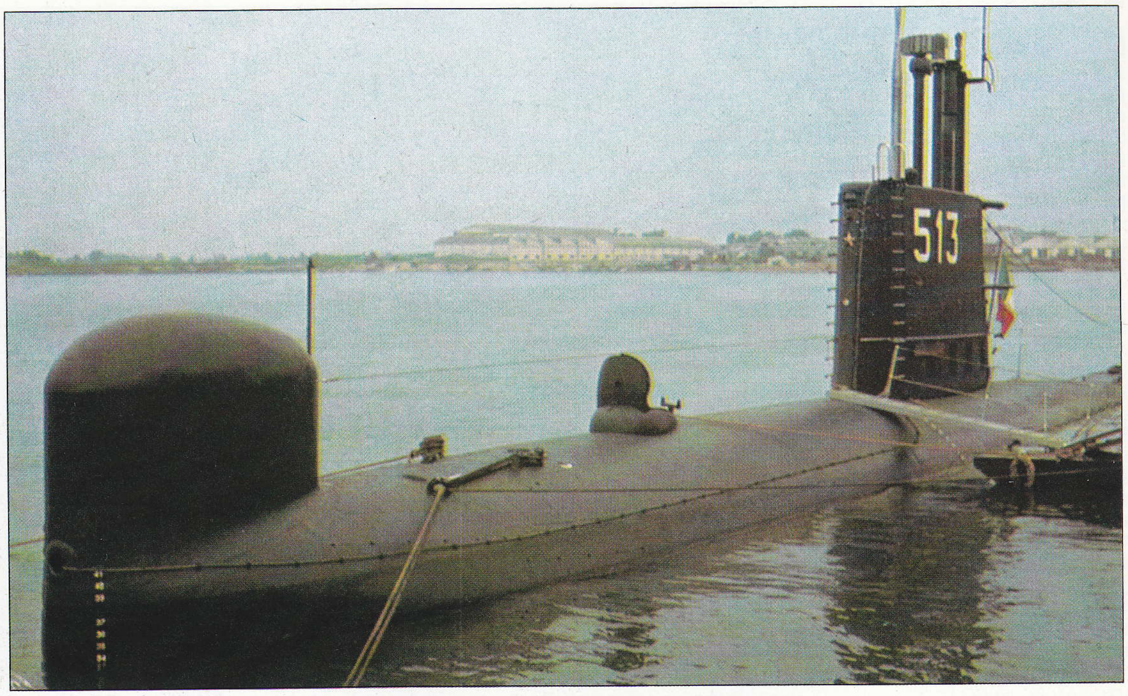
Below: Built at Komsomolsk at the rate of at least one a year, the 'Kilo' class is the first new operational diesel-electric powered design to be built for a number of years by the Soviets. It is believed that they have specialized mine-laying equipment as part of their armament.



ITALY

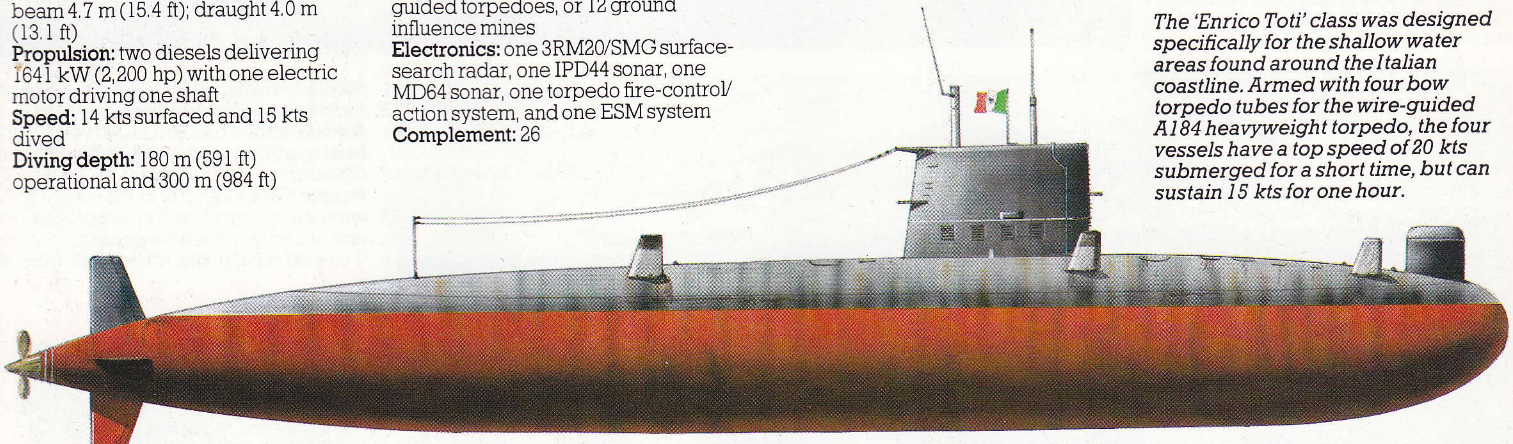
'Enrico Toti' class

As the first indigenously-built Italian submarine design since World War II, the **'Enrico Toti' class** had a chequered start as the actual plans had to be recast several times. With reasonable capabilities and performance, the four units are the ***Attilio Bagnolini*** (S505), ***Enrico Toti*** (S506), ***Enrico Dandolo*** (S513) and ***Lazzaro Mocenigo*** (S514), which entered service in 1968-9 for use in the notoriously difficult ASW conditions encountered in the central and eastern Mediterranean regions. For these operations the boats' relatively small size and minimum sonar cross-section stands them in good stead. The main armament carried is the Whitehead Motofides A184 533-mm (21-in) wire-guided torpedo. This is a dual ASW/anti-ship weapon with an active/passive acoustic-homing head that features enhanced ECCM to counter decoys launched or towed by a target. With a launch weight of 1300 kg (2,866 lb), a large HE warhead and a range in the order of 20 km (12.4 miles), the electrically-powered A184 can be used by the 'Enrico Totis' in 'ambush' situations at natural 'choke-points' to attack much larger opponents such as Soviet SSNs or SSGNs.



Third of the 'Enrico Toti' class was the Enrico Dandolo *(S513) which shows off the characteristic JP-64 active sonar system housing on the bow in this view. The crew for this relatively small class is four officers and 22 other ratings.*

Specification
'Enrico Toti' class
Displacement: 524 tons surfaced and 591 tons dived
Dimensions: length 46.2 m (151.6 ft); beam 4.7 m (15.4 ft); draught 4.0 m (13.1 ft)
Propulsion: two diesels delivering 1641 kW (2,200 hp) with one electric motor driving one shaft
Speed: 14 kts surfaced and 15 kts dived
Diving depth: 180 m (591 ft) operational and 300 m (984 ft) maximum
Torpedo tubes: four 533-mm (21-in) bow
Basic load: six A184 dual-role wire-guided torpedoes, or 12 ground influence mines
Electronics: one 3RM20/SMG surface-search radar, one IPD44 sonar, one MD64 sonar, one torpedo fire-control/action system, and one ESM system
Complement: 26



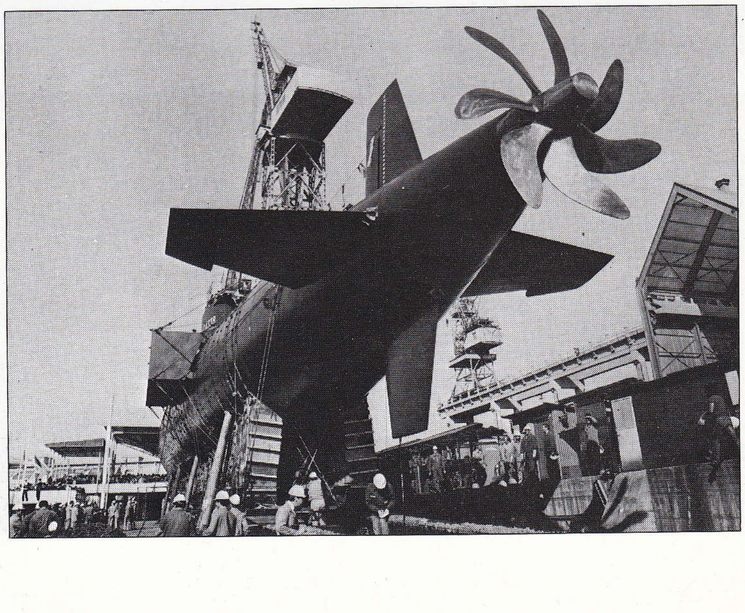
The 'Enrico Toti' class was designed specifically for the shallow water areas found around the Italian coastline. Armed with four bow torpedo tubes for the wire-guided A184 heavyweight torpedo, the four vessels have a top speed of 20 kts submerged for a short time, but can sustain 15 kts for one hour.

ITALY

'Sauro' class

During the early 1970s it rapidly became apparent to the Italian navy that a new submarine design was required for defence against amphibious landings and for ASW and anti-shipping tasks in the local area. The result was the Italcantieri design for the **'Sauro' class**, whose first two units were the ***Nazio Sauro*** (S518) and ***Carlo Fecio di Cossato*** (S519), which entered service in 1980 and 1979 respectively following major problems with their batteries. A further two units, the ***Leonardo da Vinci*** (S520) and the ***Guglielmo Marconi*** (S521) were then ordered, and these commissioned into service in 1981 and 1982. The class has a single pressure hull with external ballast tanks at the bow and stern and a buoyancy tank in the sail. The pressure hull is made from the US-developed HY80 high-tensile steel, which allows a deeper diving capability than on the previous 'Enrico Toti' design. The main armament is the Whitehead Motofides A184 dual-role wire-guided torpedo, but these can be replaced by several types of Italian ground mines if required. In February 1983 a third pair of 'Sauro' class units was ordered from Italcantieri for delivery later in the decade. These will be slightly larger and have longer torpedo tubes to accommodate the American Sub-Harpoon anti-ship missile.

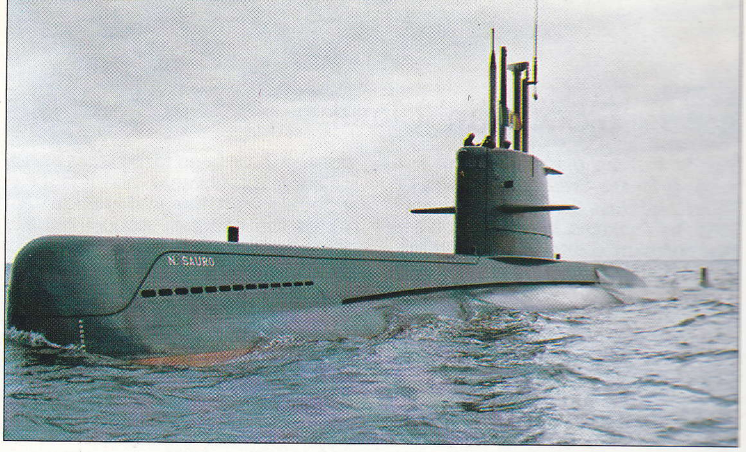
Specification
'Sauro' class
Displacement: 1,456 tons surfaced and 1,631 tons dived
Dimensions: length 63.9 m (209.6 ft); beam 6.8 m (22.3 ft); draught 5.7 m



The** Leonardo da Vinci **(S520) is launched, in October 1979. The seven-bladed propeller used on the craft is noticeable, and is typical of the improvements made to submarines since the war in order to improve their speed and manoeuvrability.

'Sauro' class (continued)

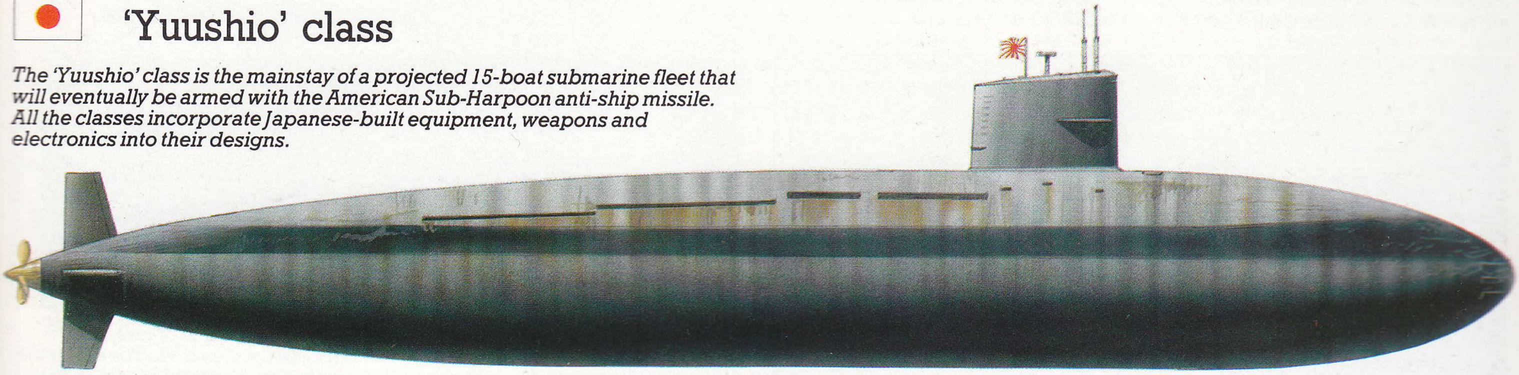
(18.7 ft)
Propulsion: three diesels delivering 2394 kW (3,210 hp) with one electric motor driving one shaft
Speed: 11 kts surfaced and 20 kts dived
Diving depth: 250 m (820 ft) operational and 410 m (1,345 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow
Basic load: 12 A184 dual-role wire-guided torpedoes, or 24 ground influence mines
Electronics: one MM/BPS704 surface-search radar, one IPD70 sonar, one Velox M5 sonar, one torpedo fire-control/action information system, and one ESM system
Complement: 45



The Nazario Sauro *(S518). A third pair of this type was authorized in the 1983 budget, with longer torpedo tubes to accommodate the American Sub-Harpoon anti-ship missile. Future naval plans will include a fourth pair if funding permits.*

JAPAN

'Yuushio' class

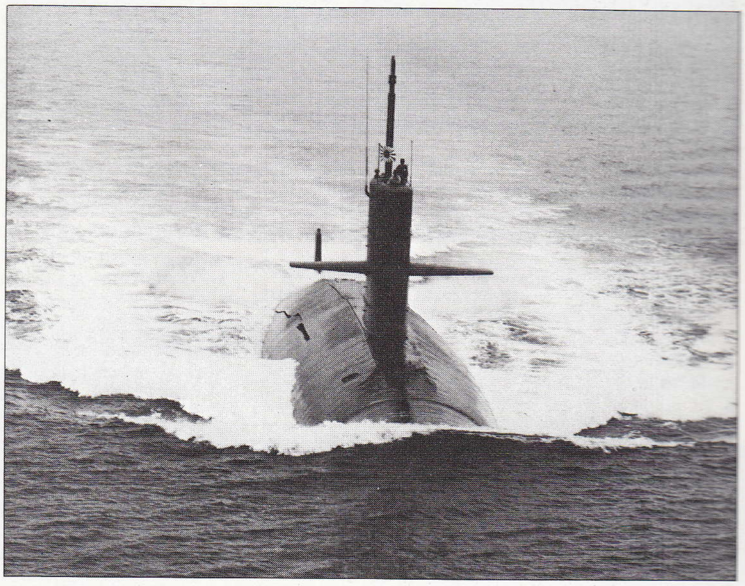


The 'Yuushio' class is the mainstay of a projected 15-boat submarine fleet that will eventually be armed with the American Sub-Harpoon anti-ship missile. All the classes incorporate Japanese-built equipment, weapons and electronics into their designs.

The latest in a long line of Japanese submarine designs, the **'Yuushio' class** is expected to total 14 units by the time construction is completed. It is essentially an enlarged version of the earlier tear-drop 'Uzushio' class with an increased diving-depth capability. Of double-hull construction, these Japanese boats follow the US Navy nuclear attack submarine practice of having a bow sonar array with the torpedo tubes moved to amidships and angled outwards. The first of the class, the ***Yuushio*** (SS573), entered service in 1980 with the ***Mochishio*** (SS574), ***Setoshio*** (SS575), ***Okishio*** (SS576, ***Nadashio*** (SS577), ***Hamashio*** (SS578) and the as yet unnamed follow-on units following at yearly intervals. From the *Nadashio* onwards the class is fitted to carry and fire the American Sub-Harpoon anti-ship missile, while to improve the torpedo armament indigenously-designed ASW and anti-ship torpedoes are about to enter production for the submarine service. The electronics carried are of the latest designs, and are known to include several licence-built American systems. A new design of submarine is currently in the initial design phase as the follow-on class for construction in the 1990s.

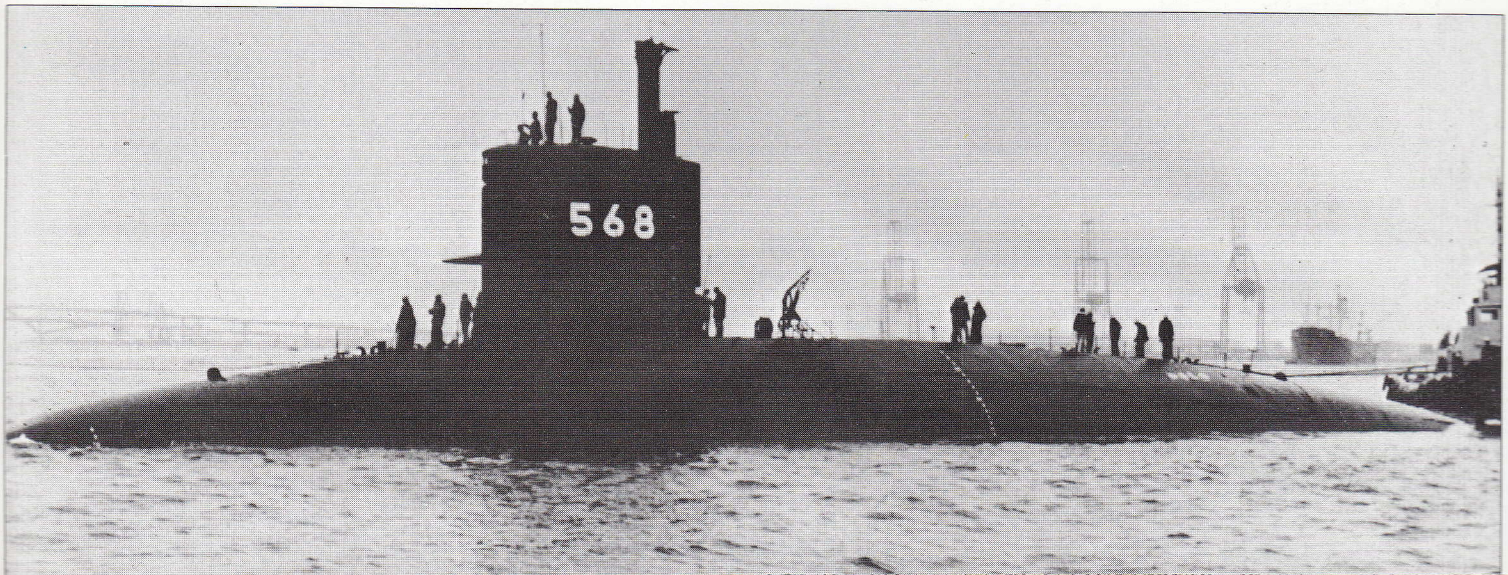
Specification

'Yuushio' class
Displacement: 2,200 tons surfaced and 2,730 tons dived
Dimensions: length 76.0 m (249.3 ft); beam 9.9 m (32.5 ft); draught 7.5 m (24.6 ft)
Propulsion: two diesels delivering 2535 kW (3,400 hp) with one electric motor driving one shaft
Speed: 12 kts surfaced and 20 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: six 533-mm (21-in) amidships
Basic load: 18 anti-submarine and anti-ship torpedoes
Electronics: one ZPS-4 surface-search radar, one ZQQ-4 bow sonar, and one SQS-36(J) sonar
Complement: 75



The Yuushio *(SS573) is equipped with automatic three-dimensional controls, remote engine control and a ZYQ-1 digital information processing system within its high-tensile steel teardrop hull structure. A new 2400-tonne type is projected to follow the 'Yuushio' class.*

The 'Yuushio' class was based on the earlier 'Uzushio' design, of which the Isoshio *was the third unit. With a double-hull teardrop shape, the 'Uzushios' introduced the angled amidships torpedo tubes into service in the early 1970s.*



SWEDEN

'Sjöormen' class

The first of the modern type of submarines for the Swedish navy was the **'Sjöormen' class** designed in the early 1960s by Kockums, Malmö and built by that company (three units) and Karlskrona Varvet (two units). The class comprises the ***Sjöormen*** (Sör), ***Sjolejonet*** (Sle), ***Sjöhunden*** (Shu), ***Sjöbjörnen*** (Sbj) and ***Sjöhästen*** (Shä). With an 'albacore' type hull for speed and a twin-deck arrangement the class is extensively used in the relatively shallow Baltic, where its excellent manoeuvrability and silent-running capabilities greatly aid the Swedish navy's ASW operations. The control surface and hydroplane arrangements are the same as those fitted to the latter Swedish submarine classes, and it is these together with the hull design that allows the optimum manoeuvrability characteristics to be used throughout the speed range, though they are more noticeable at the lower end: for example, a 360° turn can be achieved in five minutes within a 230-m (755-ft) diameter circle at a speed of 7 kts underwater; if the speed is increased to 15 kts the same turn will take only two and a half minutes, which means the class can easily out-turn most of the Warsaw Pact ASW escorts encountered in the Baltic, as well as most of the NATO escorts.

Specification

'Sjöormen' class

Displacement: 1,125 tons surfaced and 1,400 tons dived

Dimensions: length 51.0 m (167.3 ft); beam 6.1 m (20.0 ft); draught 5.8 m (19.0 ft)

Propulsion: four diesels delivering 2,100 hp (1566 kW) with one electric motor driving one shaft

Speed: 15 kts surfaced and 20 kts dived

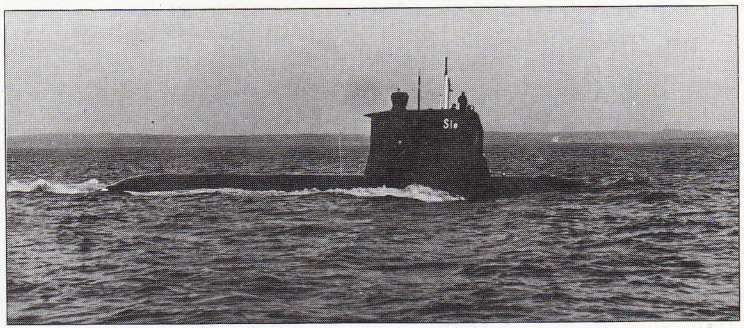
Diving depth: 150 m (492 ft) operational and 250 m (820 ft) maximum

Torpedo tubes: four 533-mm (21-in) bow and two 400-mm (15.75-in) bow

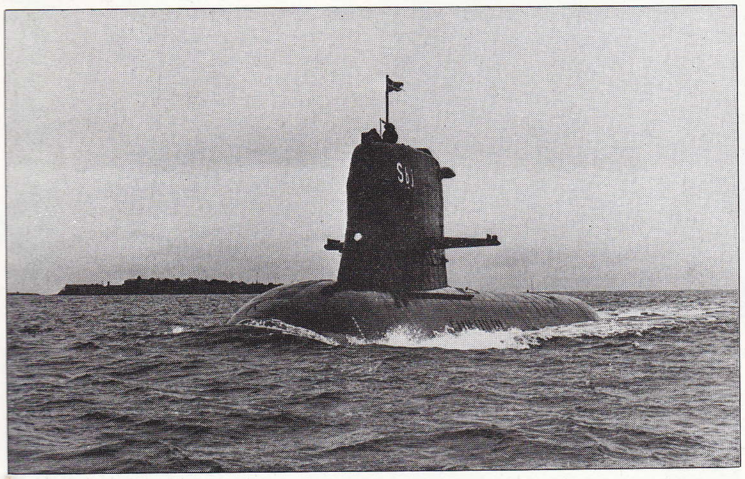
Basic load: eight Type 61 533-mm (21-in) anti-ship wire-guided torpedoes or 16 influence ground mines, plus four Type 42 anti-submarine wire-guided torpedoes

Electronics: one Terma surface-search radar, one low-frequency sonar, one torpedo fire-control/action information system, and one ESM system

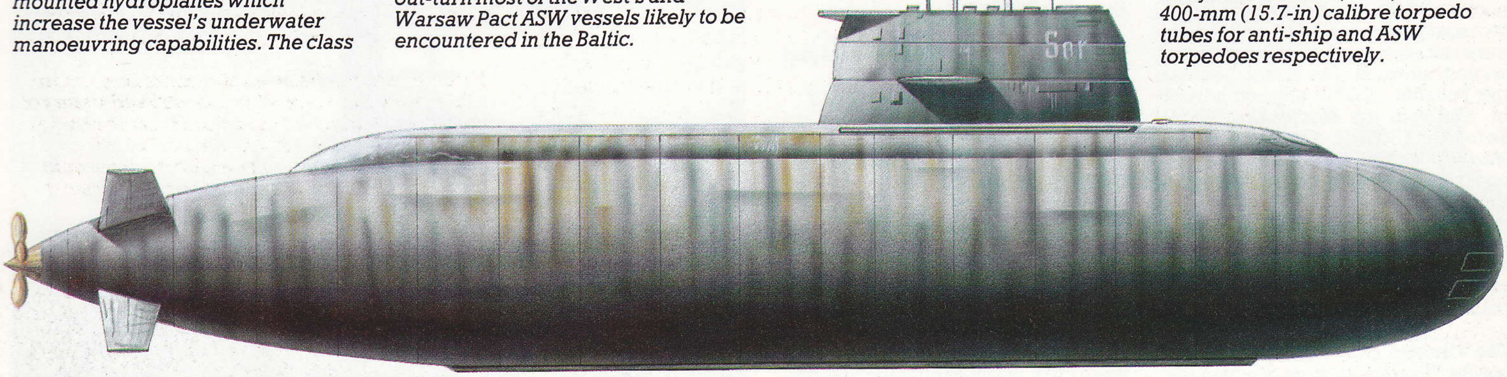
Complement: 18



The Sjölejonet (Sle) of the 'Sjöormen' class runs on the surface in the submarine's major operating area of the Baltic. In such a region speed and manoeuvrability is of greater importance than diving depth, since much of the sea is relatively shallow.



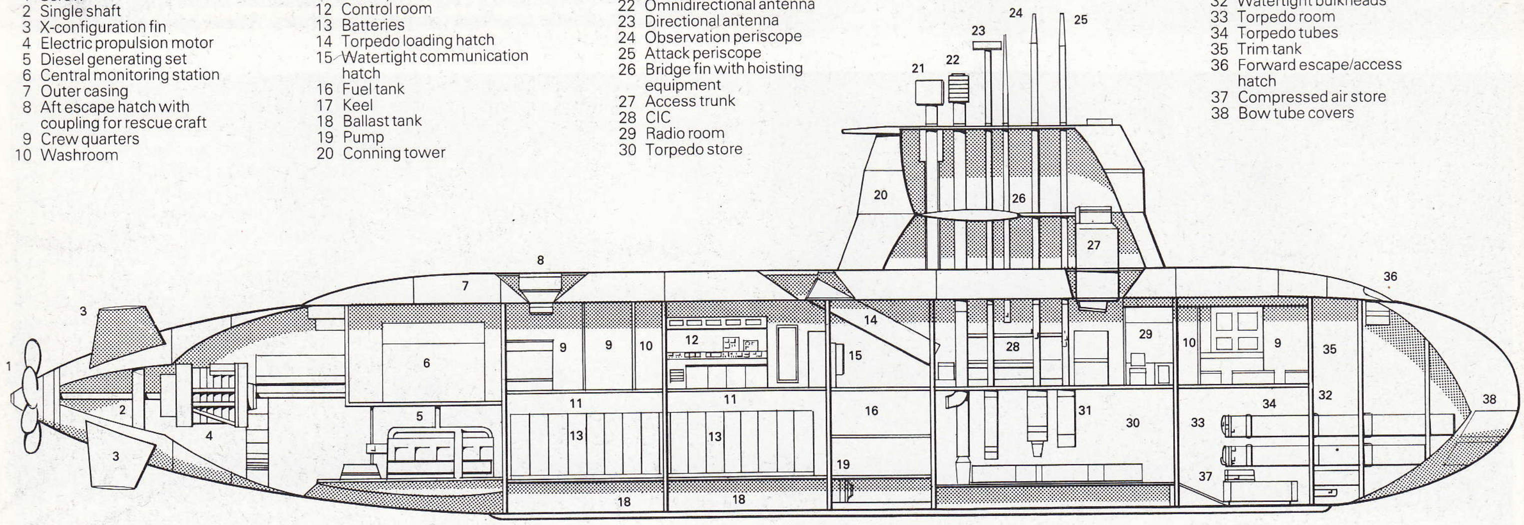
The Sjöbjörnen (Sbj) shows the sail-mounted hydroplanes which increase the vessel's underwater manoeuvring capabilities. The class can, at medium speeds submerged, out-turn most of the West's and Warsaw Pact ASW vessels likely to be encountered in the Baltic.



The five vessels of the 'Sjöormen' class are designated the Type-A11B by their builders. Fitted with X-configuration stern planes for increased manoeuvrability, they carry four 533-mm (21-in) and two 400-mm (15.7-in) calibre torpedo tubes for anti-ship and ASW torpedoes respectively.

Sjöormen cutaway drawing key

1 Screw
2 Single shaft
3 X-configuration fin
4 Electric propulsion motor
5 Diesel generating set
6 Central monitoring station
7 Outer casing
8 Aft escape hatch with coupling for rescue craft
9 Crew quarters
10 Washroom
11 Battery room
12 Control room
13 Batteries
14 Torpedo loading hatch
15 Watertight communication hatch
16 Fuel tank
17 Keel
18 Ballast tank
19 Pump
20 Conning tower
21 Snorkel
22 Omnidirectional antenna
23 Directional antenna
24 Observation periscope
25 Attack periscope
26 Bridge fin with hoisting equipment
27 Access trunk
28 CIC
29 Radio room
30 Torpedo store
31 Periscope wells
32 Watertight bulkheads
33 Torpedo room
34 Torpedo tubes
35 Trim tank
36 Forward escape/access hatch
37 Compressed air store
38 Bow tube covers



Silent Running-The Diesel Option

The difficulty with which Norway and Sweden have made any identification of submarine incursions into their territorial waters in the last few years may seem surprising in view of the high technology poured into anti-submarine warfare in the past decade. What might detect a nuclear submarine in the ocean, however, is unlikely to be much use in pinpointing a small, quiet boat in the shallow waters of the Continental Shelf.

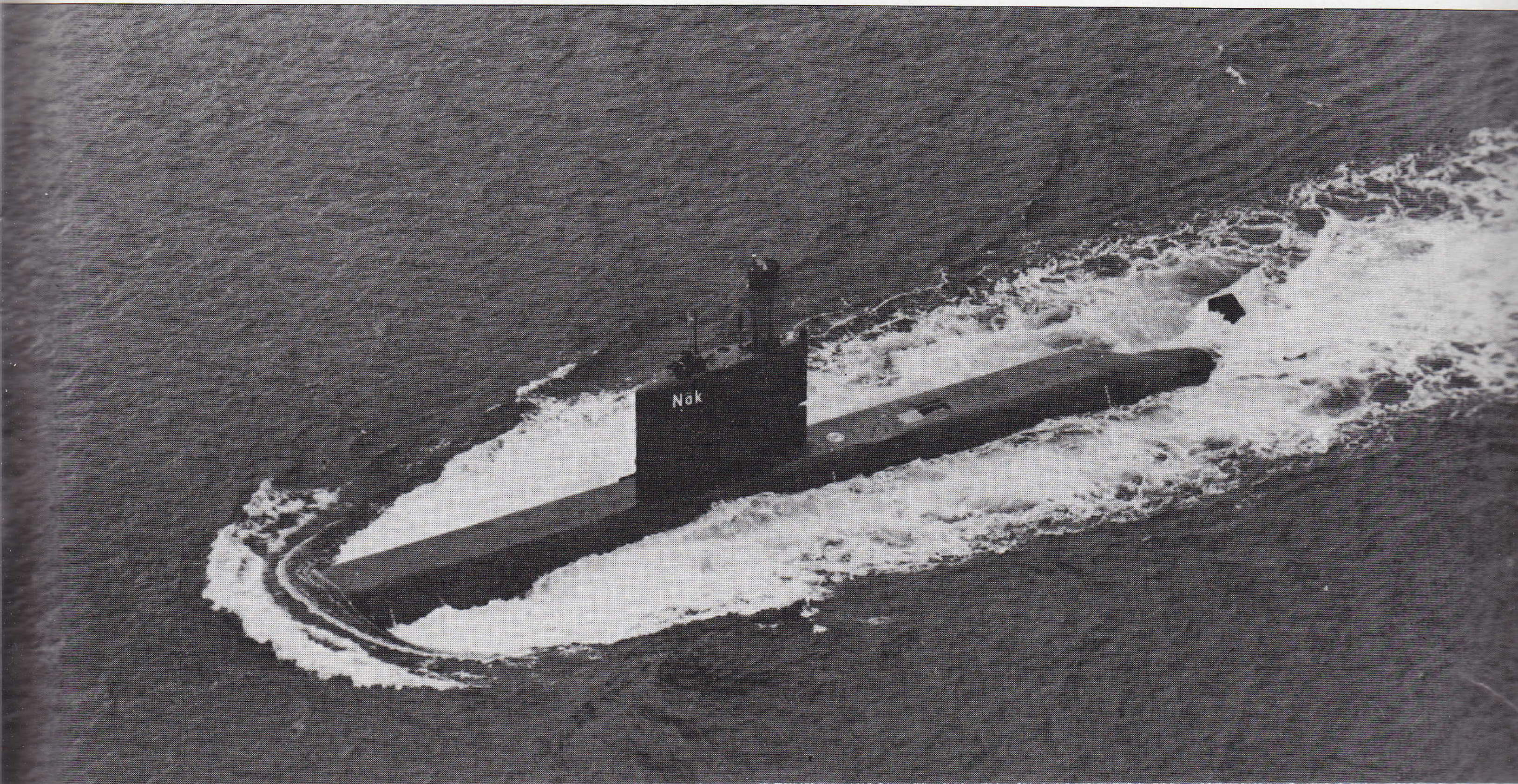
The Royal Navy's new 'Type 2400' class submarines are to be diesel-electric powered. But is it yet another example of hanging onto past glories, or that the services are being provided with inferior equipment? After all, are not nuclear submarines the proven best and most practical submarines available? A simple 'no' answers all these questions and the recent fiascos off the south coast of Sweden illustrate the advantages and disadvantages of both types of submarine. But before considering these events it is instructive to look at the operational requirements that led to the development of both diesel and electric submarines.

Submarines were first seriously proposed in the 18th century, although primitive diving bells and diving suits had been used much earlier. The early construction history is a combination of genius, farce and tragedy. Many submarines sank on their first voyage with all hands. Many would not sink at all. One of the potentially most successful designs (American) was turned down by the French navy on the grounds that it was too horrible a weapon. However, the submarine's first effective missions were undertaken during the American War of Independence, and by the end of the 19th century all the world's major navies were equipped with at least a few submarines. Paradoxically the UK, which has now subordinated all its armed forces to the nuclear submarine/Trident missile programme, was one of the last countries to accept the submarine as a viable weapon.

Initially, this new type of warship was powered by petrol engines, which were noisy, inefficient and highly dangerous. (Needless to say, only one steam-powered submarine operated in World War I, namely the British 'K' class.) By 1912, all the major navies had replaced petrol by diesel engines, and the use of the snorkel tube allowed diesel engines to run even while the submarine was below the surface. Later, however, it became apparent that the submarine would often have to dive to a depth at which the snorkel tube simply could not operate: thus there appeared the combination diesel-electric submarine, and the rest is recent history: certainly Germany came extremely close to winning the war at sea with her U-boat forces in both world wars. Life in both German and Allied submarines was nasty, brutish and inclined to be short. The Americans called their submarines pig boats because that is exactly how any submarine smelt after a few weeks at sea.

Aside from the cramped and squalid living conditions, one of the greatest problems with diesel submarine was refuelling, because in order to refuel they had either to return to a shore base or rendezvous with a tanker on the surface, where they are at their most vulnerable. Also, refuelling at sea in a heavy swell can be extremely difficult, not to mention dangerous. In a storm it was well nigh impossible. So when the keel of the USS *Nautilus*, the world's first nuclear-powered submarine, was laid in June 1952, it seemed that the diesel submarine's days were numbered, at least as far as the major powers were concerned. This was later emphasized when the *Nautilus* sailed 169190 km (105,130 miles) on a single fuelling of Uranium 235 (now superseded by enriched uranium), 148250 km (92,118 miles) of them submerged.

But it was the increasingly sophisticated use of advanced electronics for anti-submarine warfare (ASW) that re-emphasized the role that diesel-electric submarines could play. Basically, it is far harder to detect a diesel-electric submarine than a nuclear submarine. Secondly, nuclear submarines take up to three years to build and are extremely expensive, so that they are simply not cost-effective in certain roles where their chances of being damaged or destroyed are high. In many ways, nuclear submarines are more fragile than their humble relations, and it is relatively easy to see why this is the case. Nuclear powerplants are fairly complex creations. In a submarine, the nuclear pile is used to heat water to steam which in turn runs a turbine, providing direct drive to the propeller shaft(s) and electric generators used in turn to power the boat's electronics and/or to provide an alternative propulsion system via battery storage. (Electric motors are still the quietest available, and are used for silent running, when the boat goes into an ultra quiet state.) In other words, there is an awful lot that can go wrong in a nuclear submarine, particularly when some unfriendly soul is dropping depth charges in the vicinity: it does not need a



Nowhere are modern diesel-electric boats more relevant than in the shallow, constricted waters of the Baltic. In the potentially deadly game of hide and seek played out among the islands, the massive power of the nuclear submarine would stand out like a bull in a china shop, hence most boats are small, like the Swedish Näcken.

direct hit to fracture a steam pipe. Another weakness is the life-support system. Nuclear submarines are designed to stay beneath the surface for months on end. Therefore, the life support systems have to be fairly complex; if battery capacity is the permanent worry of the captain of a diesel submarine, the maintenance of good air on his boat is the permanent worry of a nuclear submarine commander. A simple combination of circumstances could result in a small but poisonous phosgene gas discharge (for example by an overcorrection in oxygen levels coupled with a freon gas leak from the refrigeration system) and that could force the nuclear submarine up to periscope depth in order to recycle its air. And that would greatly increase its chance of detection.

Nuclear/diesel contrast

However, nuclear submarines are appreciably faster than diesel-electric submarines. An average of over 30 kts submerged is claimed for most of them, while the Soviet 'Alpha' class submarines are reported to have a maximum submerged speed in excess of 40 kts, as are the monster Soviet 'Typhoon' class units, which each have not one but three nuclear reactors. And because nuclear submarines are larger than diesel submarines (more power from the plant allows for a bigger boat) there is more room for weapon systems, electronic warfare systems and electronic countermeasures systems. Today there are two types of nuclear submarines: those equipped to fire ballistic and cruise missiles, and those designed to destroy such submarines. All of this leaves the diesel-electric submarine with an interesting and vital role to play. True, it is possible to equip a diesel-electric submarine with surface-fired cruise missiles, but that is ignoring their advantage over their big brothers: a diesel-electric submarine is smaller and quieter than a nuclear submarine, which is why a Soviet 'Whiskey' class conventional submarine finally ran aground in Swedish territorial waters. Simply put, diesel-electric submarines are best suited to clandestine reconnaissance, inshore sabotage and inshore minelaying tasks, and this is exactly how they are used by all the major navies of the world. The problem of refuelling at sea has reportedly been solved by NATO forces, using methods ranging from an umbilical passed from a surface tanker to the submarine below, to a submarine refuelling from a static supply dump actually fixed to the bottom of the sea, and which may or may not be in friendly waters. And since the diesel submarine's efficiency has improved by at least 1,000 per cent over the World War II variety, one can safely expect them to be in use for many years to come.

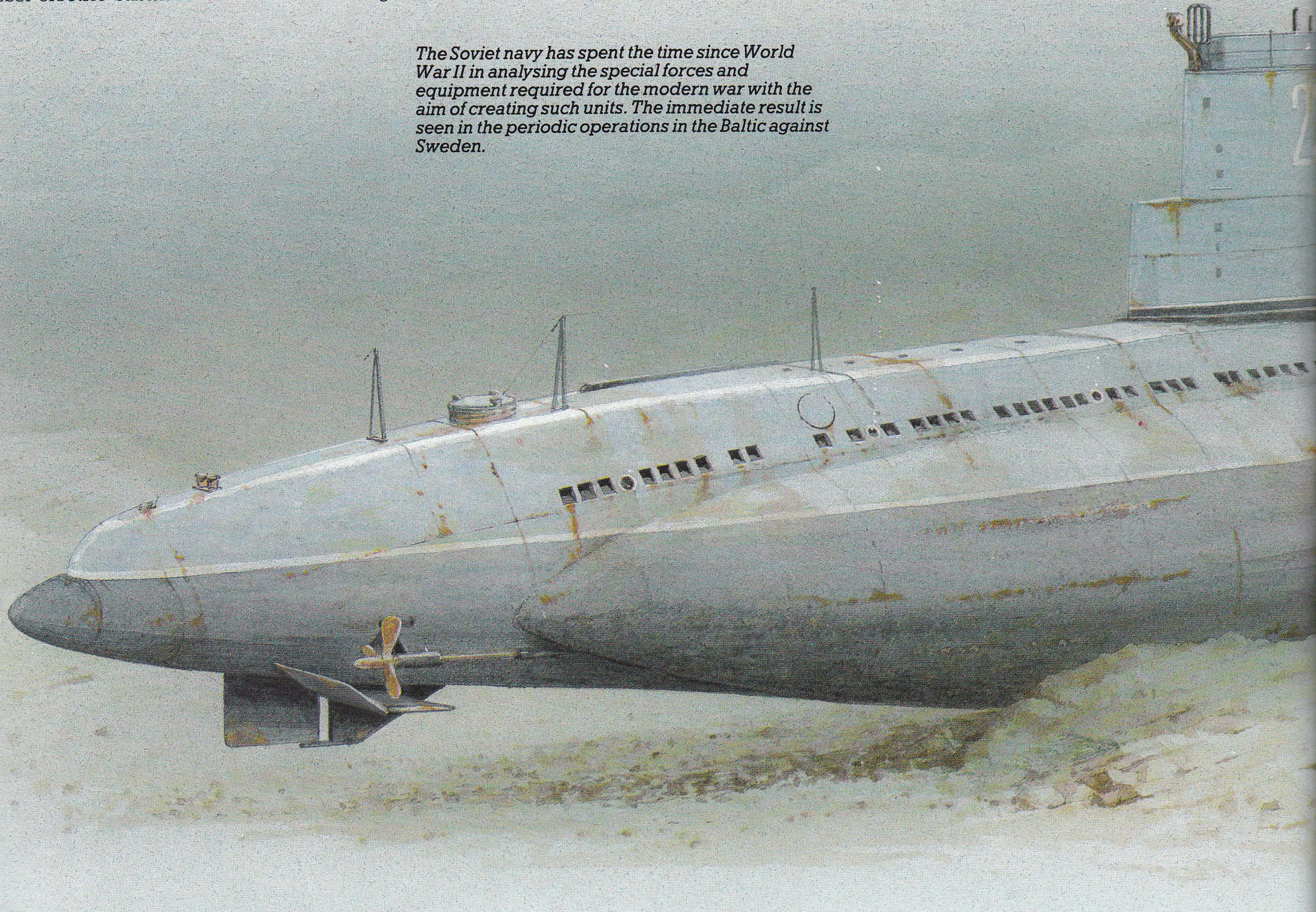
Baltic operations

But what about that 'Whiskey' class submarine stranded in Sweden? The Soviets have a very considerable fleet in the Baltic, based on Leningrad, and a glance at the map shows that for that fleet to get out of the Baltic, it has to send its submarines to run the gauntlet initially between the Danish island of Zeeland and southern Sweden, and then between Denmark and Sweden (the Skaggerak) before they can escape into the North Sea. There, incidentally, in time of war units of various navies would be waiting to clobber them. Similarly, that narrow channel between Sweden and Norway also makes it that much harder for a NATO fleet to steam into the Baltic.

Solo missions

One should not think only in terms of fleets steaming in either direction, however, but also take recognizance of individual submarines, particularly nuclear submarines carrying intercontinental ballistic missiles. Needless to say, some time before war actually broke out, both sides would try to increase the number of their nuclear submarines at sea: the Soviets would try to get as many under the shelter of the Arctic ice cap as possible, while the Americans would try to get as many of their hunter killers as close into the Soviet mainland (and major ports) as possible.

Given the long range and accuracy of the Trident missiles carried by the 'Ohio' class boats of the US Navy, it is likely that they would be launched from remote locations probably safe from Soviet interference. Thus Soviet attack submarines would probably see their main duty as protecting their own SSBNs. It is in



The Soviet navy has spent the time since World War II in analysing the special forces and equipment required for the modern war with the aim of creating such units. The immediate result is seen in the periodic operations in the Baltic against Sweden.

that protection that the diesel-electric submarine can play a part – in its 'silent state' it can lie in wait, undetected by the faster but noisier nuclear-powered submarine.

From the NATO point of view, it is known that the Soviets keep 13 nuclear submarines at sea at any given time. So if this number suddenly increased, it would be a fair indication that something was up, and that something could be the imminence of war.

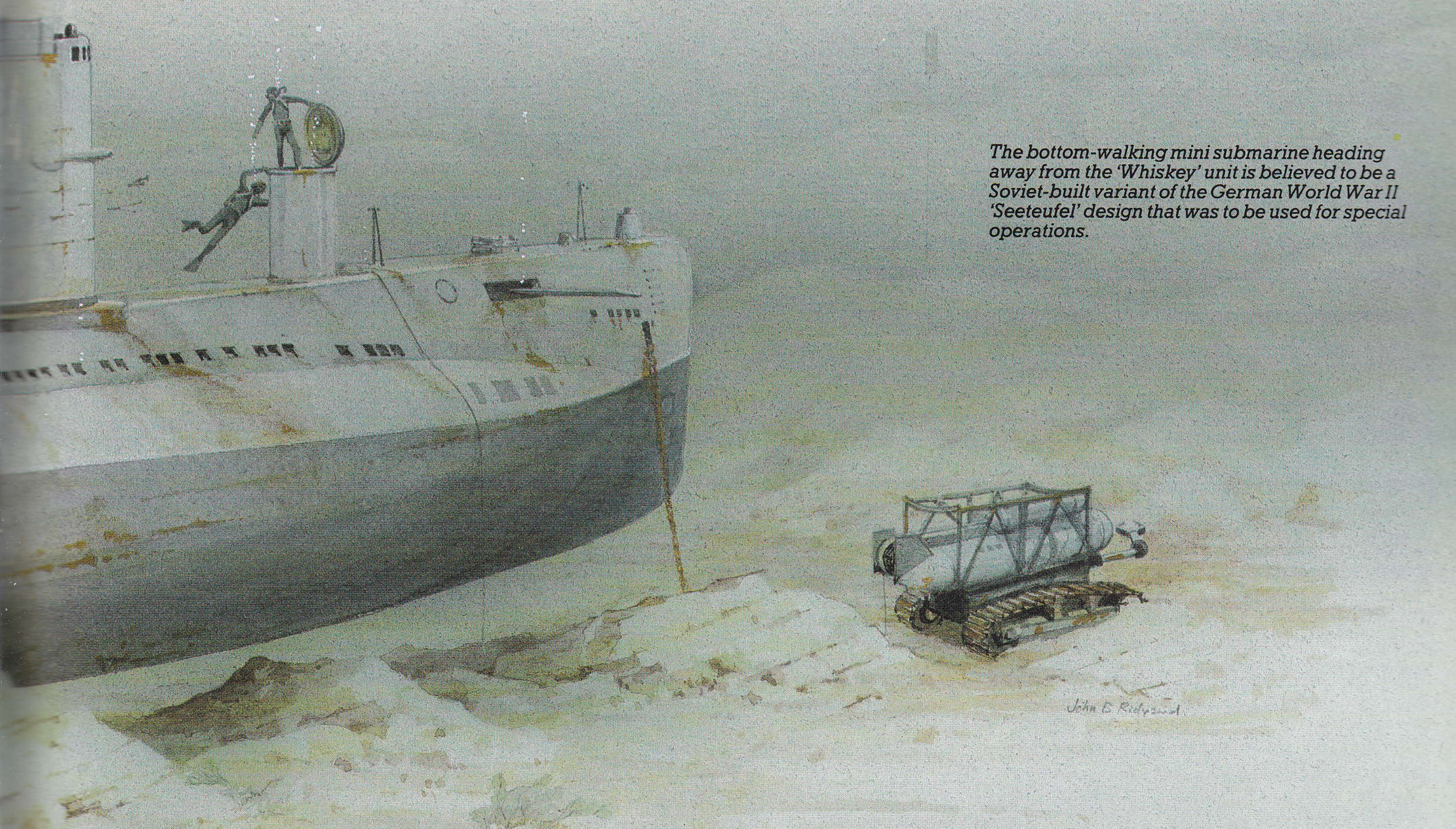
Swedish defences

In military terms, the Swedish/Danish channel is a 'choke point', and there is no doubt that it is strewn with listening devices and detection devices of one kind or another. As has been seen, nuclear submarines are noisier than diesel-electric submarines. They can also be identified by propeller noise and hydrodynamic noise, which is the flow of water over the hull interrupted by various protrusions and orifices. Soviet submarines have always been noisier in this way, mainly because of the continued use of free-flood holes. Now although Sweden is avowedly neutral, past experience has shown that in Soviet eyes the only neutral country is one that is basically sympathetic to the Soviet cause and can be relied upon to do the decent thing in time of war. Actually, the fact remains that so important is Sweden in strategic terms that neither side could allow her to remain neutral in time of war. However, since Sweden is not part of NATO, the Soviets probably do not know as much as they would like about the type of underwater detection devices the Swedes undoubtedly use, devices ranging from active sonar to passive hydrophones. The Soviets have thus been using their 'Whiskey' class submarines to examine the Swedish defences (coupled with diving teams and small tracked submersibles that can examine the sea bottom) for several years. They would, in time of war, use the same submarines to lay nuclear mines, both to deny the Baltic to incoming ships or submarines and to keep Swedish vessels bottled up in port, a role emphasized by the fact that nuclear radiation was detected in the bows of the stranded Soviet submarine, a diesel-electric type.

It is a common fallacy that if war should ever break out between NATO and the Soviets, all participating countries would be nuclear-bombed within a matter of hours. Far more likely is a Soviet conventional advance (using, at the very most, low-yield battlefield nuclear weapons) in Western Europe, which would necessitate Atlantic resupply convoys from the USA and Canada to the UK and the Channel ports. If the Soviets could prevent those convoys from getting through, NATO commanders would be forced to decide between negotiated surrender or the move to strategic nuclear weapons, an escalation that would bring, at best, a very hollow victory. Thus the war at sea is of enormous strategic significance; and the Soviets can no more allow NATO hunter/killer nuclear submarines into the Baltic to interdict their own fleets than they can allow themselves to be bottled up in the Baltic.

Finally, there is a point here that many commentators seem to have missed. Given that the Soviet submarine was carrying nuclear mines when she stuck on the sandbank, there is no indication of the nuclear mines' origins. It is quite conceivable that the submarine, rather than laying mines or going through the exercise of laying mines, was simply snitching a couple belonging to someone else.

This is one of the specially-modified 'Whiskey V' class diesel submarines converted to the frogman-carrying role, with a diver lock-out chamber forward. Used with the naval Spetsnaz brigades, these vessels regularly operate within Swedish and Norwegian territorial waters on training and reconnaissance missions.



The bottom-walking mini submarine heading away from the 'Whiskey' unit is believed to be a Soviet-built variant of the German World War II 'Seeteufel' design that was to be used for special operations.

SWEDEN

'Vastergötland' class

Designed by Kockums, Malmö under a 1978 contract, the four vessels of the **'A-17'** or **'Vastergötland' class** were ordered in 1981. The bows and sterns were built by the Karlskrona, Varvet shipyard and the mid-bodies and final assembly by Kockums. The ***Vastergötland*** (Vgd), ***Hälsingland*** (Hgd), ***Södermanland*** (Söd) and ***Östergotland*** (Ögd) are all due to enter service in the period 1987-9. The internal arrangement of the two main watertight compartments allows sufficient space for six spare berths for trainee submariners. Each compartment is also provided with its own set of fittings for deep-diving rescue vessels such as the Swedish URF. The control surfaces are arranged in an X-configuration that is connected in pairs to two separate hydraulic systems and, until fairly recently, was a purely Swedish submarine design feature. Only two of the control surfaces are used at any one time for manoeuvring, thus providing a high measure of redundancy except in the case of a direct hit right aft by a torpedo. Two hydroplanes are also fitted to the sail and are connected to a common control shaft. The torpedo tubes are arranged in the unique Swedish arrangement of the four long 533-mm (21-in) tubes over the two short 400-mm (15.75-in) tubes. Each tube set has its own reload compartment. The larger tubes can also be used for influence ground mines in place of the torpedo load. The class may also be fitted in the sail with four vertical launch tubes for the RBS 17 anti-ship missile variant of the air-launched Bofors RBS 15 missile.

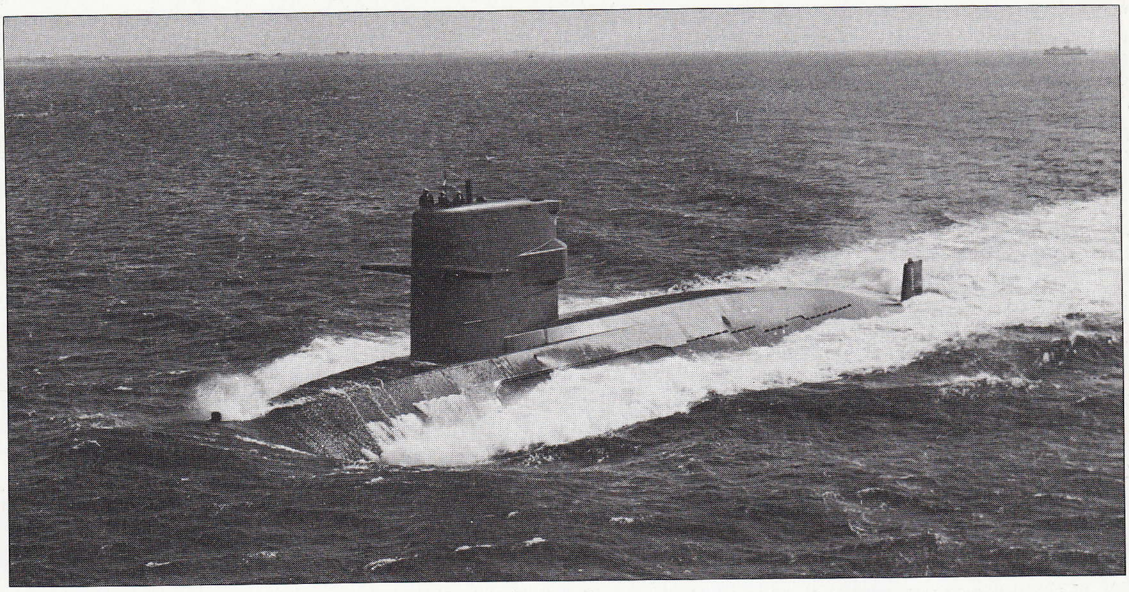
Specification
'Vastergötland' class
Displacement: 1,070 tons surfaced and 1,140 tons dived
Dimensions: length 48.5 m (159.1 ft); beam 6.1 m (20.0 ft); draught 6.1 m (20.0 ft)
Propulsion: two diesels delivering 1611 kW (2,160 hp) with one electric motor driving one shaft
Speed: 12 kts surfaced and 20 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: four 533-mm (21-in) bow and two 400-mm (15.75-in) bow
Basic load: eight Type 61 533-mm (21-in) anti-ship wire-guided torpedoes or 16 influence ground mines, plus four Type 42 anti-submarine wire-guided torpedoes
Electronics: one Terma surface-search radar, one low-frequency sonar, one torpeo fire-control/action information system, and one ESM system
Complement: 21

NETHERLANDS

'Zwaardvis' and 'Walrus' classes

Based on the US Navy's teardrop hulled conventional submarine 'Barbel' class, the ***Zwaardvis*** (S801) and ***Tijgerhaai*** (S807) of the **'Zwaardvis' class** were ordered in the mid-1960s. Because of the requirement to use indigenous Dutch equipment wherever possible, the design was modified. These modifications included the placement of all noise-producing machinery on a false deck with spring suspension for silent running. The two units entered service with the Dutch navy in 1972.

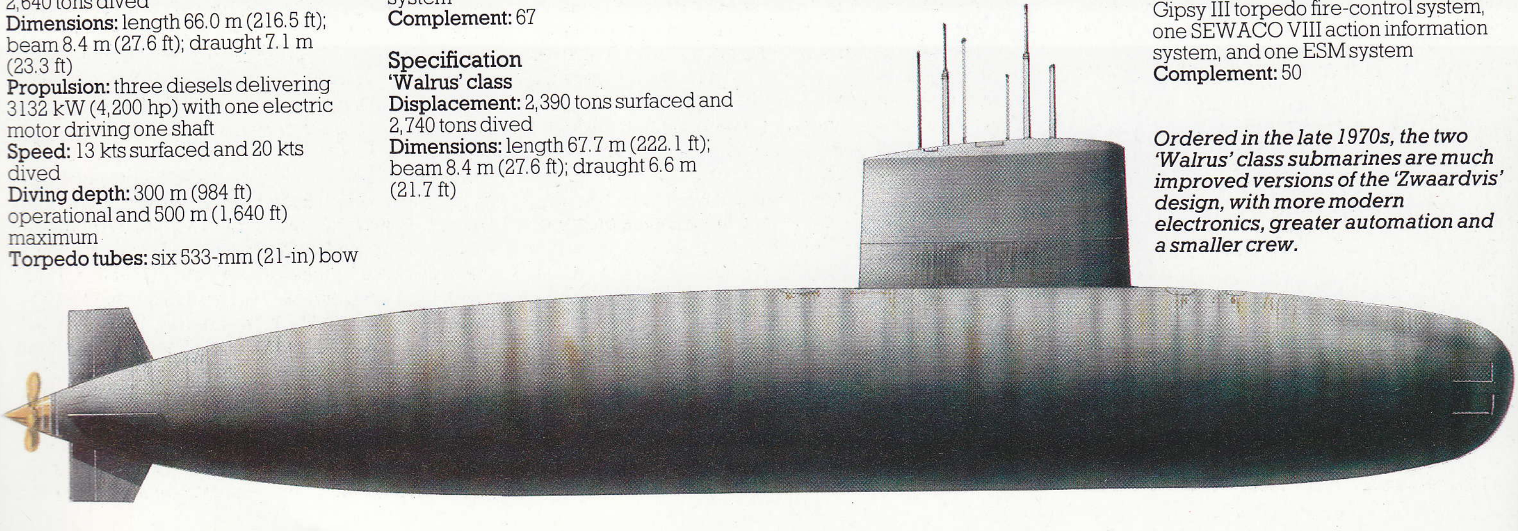
At the same time the need began to arise to start the design of a new class to replace the elderly 'Dolfijn' and 'Potvis' classes. The new design evolved as the **'Walrus' class**, and was based on the 'Zwaardvis' hull form with similar dimensions and silhouette but with more automation, a smaller crew, more modern electronics, X-configuration control surfaces and the French MAREI high-tensile steel hull material that allows a 50 per cent increase in maximum diving depth. The first unit, the ***Walrus*** (S802), was laid down in 1979 for commissioning in 1986 and the second, ***Zeeleeuw*** (S803), a year later for service entry in 1987. A further pair is due to be laid down in 1986, with the final pair in 1991. In 1981 Taiwan ordered a pair of **'Improved Zwaardvis' class** units for her navy, and these will be delivered in mid-1985 and mid-1986 respectively.



The Zwaardvis (S806) runs at speed on the surface. Based on the American 'Barbel' class with a teardrop hull, she uses a large proportion of Dutch-designed and -built equipment internally and has all noise-producing machinery mounted on a spring-suspended false deck.

Specification
'Zwaardvis' class
Displacement: 2,350 tons surfaced and 2,640 tons dived
Dimensions: length 66.0 m (216.5 ft); beam 8.4 m (27.6 ft); draught 7.1 m (23.3 ft)
Propulsion: three diesels delivering 3132 kW (4,200 hp) with one electric motor driving one shaft
Speed: 13 kts surfaced and 20 kts dived
Diving depth: 300 m (984 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow
Basic load: 20 Mk 37C anti-submarine and Mk 48 dual-role wire-guided torpedoes, or 40 influence ground mines
Electronics: one Type 1001 surface-search radar, one low-frequency sonar, one medium-frequency sonar, one WM-8 torpedo fire-control/action information system, and one ESM system
Complement: 67

Specification
'Walrus' class
Displacement: 2,390 tons surfaced and 2,740 tons dived
Dimensions: length 67.7 m (222.1 ft); beam 8.4 m (27.6 ft); draught 6.6 m (21.7 ft)
Propulsion: three diesels delivering 4101 kW (5,500 hp) with one electric motor driving one shaft
Speed: 13 kts surfaced and 20 kts dived
Diving depth: 450 m (1,476 ft) operational and 620 m (2,034 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow
Basic load: 20 Mk 37C anti-submarine and Mk 48 dual-role wire-guided torpedoes, or 40 influence ground mines
Missiles: Sub-Harpoon underwater-to-surface anti-ship missiles can be carried in place of torpedoes
Electronics: one Type 1001 surface-search radar, one Octopus bow sonar, one Type 2024 towed-array sonar, one Gipsy III torpedo fire-control system, one SEWACO VIII action information system, and one ESM system
Complement: 50



Ordered in the late 1970s, the two 'Walrus' class submarines are much improved versions of the 'Zwaardvis' design, with more modern electronics, greater automation and a smaller crew.

Armed Forces of the World

Soviet Air Forces

Part 4

Sole fixed-wing carrier aircraft employed by the Soviet navy aboard its four carriers (Minsk, Novorossisk, Kharkov and Kiev) is the Yakovlev Yak-38 'Forger-A' and its two-seat trainer version. These aircraft are V/STOL capable but do not possess the performance of the Sea Harrier because they employ lift engines which act as deadweight when the aircraft is in level flight.

Until recent years, the post-revolutionary Soviet navy (Voyenno-Morskoy Flot, or VMF) restricted its activities to coastal defence, augmented by long-range strike aircraft operating from land bases. Now, in an immense expansion programme still in progress, the USSR is acquiring the ability to project its military power anywhere on the world's oceans. Small aircraft-carriers are in service, and a larger vessel on the stocks, stressing the role which aircraft will play in the achievement of this augmented capability.

Aviatsiya-VMF (Naval Aviation) is a comparatively large air arm of over 1,500 aircraft assigned to the four surface fleets: the Baltic Fleet (275 aircraft), Northern Fleet (425), Black Sea Fleet (405) and Pacific Fleet (440). Equipment is grouped into Regiments each of two squadrons, plus an HQ, and whilst two or three strike regiments constitute a Division, reconnaissance, anti-submarine warfare (ASW) and transport regiments operate autonomously.

Since the great carrier battles of World War II, it has been recognized that naval power requires air cover in order to operate (and even to exist) in a hostile environment. Thus, between 1976 and late 1984, the VMF commissioned four 'Kiev' class ASW carriers of 37,000 tons, equipped with a 185-m (607-ft) angled deck; the first three of these are now in service with all except the Baltic Fleet. This is just the beginning: a full-size carrier is presently under construction at Nikolayev, on the Black Sea, and this will catapult-launch conventional fixed-wing aircraft of as-yet unknown types when in service.

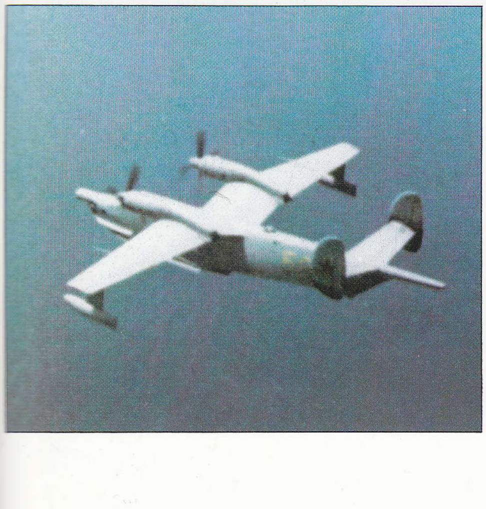
Befitting the novelty of the VMF of the ASW carrier, these vessels have been equipped with new aircraft. The Yakovlev Yak-36MP 'Forger' fighter-bomber caused a minor sensation in the West when first seen on the *Kiev* in July 1976, and similar aircraft now serve on board the *Minsk* and *Novorossisk* and are assigned to the latest addition, the *Kharkov*, at the rate of about a dozen to each. Powered by a horizontal turbojet and two lift engines, the Yak-36 (including its two-seat 'Forger-B' trainer variant) is a rudimentary design lacking operational equipment such as radar. It is a whole generation behind the BAe Sea Harrier, but such does not indicate that the USSR wishes to remain second-best in this area for long.

In addition, the ASW carriers operate around 20 helicopters. At first, these were the Kamov Ka-25 'Hormone' (16-22 ASW 'Hormone-As' and three 'Hormone-Bs' to provide over-the-horizon targeting information for surface-launched anti-ship missiles). Recently, the Ka-27 'Helix' has been deployed, this being a similar intermeshing rotor design having a longer fuselage and only two fins; it is expected to replace the 180 Ka-25s in naval service. The 'Helix-A' and 'Helix-B' operate in the same roles as their 'Hormone' predecessors, and will also serve aboard the helicopter carriers *Moskva* and *Leningrad* (18 each) and on the stern platforms of 'Kara' and 'Kresta' class cruisers.

The main weight of Aviatsiya-VMF airpower is based on airfields in the coastal regions, where 400 bombers and as many ASW, reconnaissance and tanker aircraft form a formidable striking force. Spearheading this are 110 Tupolev Tu-22M 'Backfires' (additional to those operated by the air force) armed with AS-4 'Kitchen' cruise missiles fitted with a conventional (1000-kg/2,205-lb) or nuclear (350-kiloton) warhead. Two 'Backfire' regiments are assigned to anti-shipping strike with the Northern Fleet (concentrated in the Kola Peninsula and around Arkhangelsk) and one to each of the other three fleets.

Numerically the most significant bomber is the Tupolev Tu-16 'Badger', the navy having some 250 'Badger-Cs' with AS-2 'Kippers' and 'Badger-Gs' carrying AS-5 'Kelts'. These are operated in the tactical role, but both 'Badgers' have also been seen with a pair of underwing AS-6 'Kingfish' Mach 3 missiles of 220-km (135-mile) low-altitude range.

In the Baltic area, a regiment of 35 Sukhoi Su-17 'Fitter-Cs' is assigned to anti-ship and amphibious support roles with a variety of appropriate ordnance, including the AS-7 'Kerry'. This small missile, which also arms the 'Forger', has a 100-kg (220-lb) HE warhead and a range of 11 km (7 miles).



About 80 Beriev M-12 'Mail' amphibians remain in service, mostly in the Northern and Black Sea fleets. These are used for offshore anti-submarine and general maritime surveillance patrols. Power is provided by two Ivchenko AI-20D turboprops which give the 'Mail' a top speed of 608 km/h (378 mph).

Converted bombers continue to serve a useful role in Naval Aviation, the 'Badger' again predominating: there are about 100 in the electronic role, 15 reconnaissance versions and a few tankers. A few Myasishchev M-4 'Bisons' also undertake reconnaissance, as do 95 Tupolev Tu-142 'Bears' and 40 Tu-22 'Blinders'. Tu-142s are almost equally divided between the 'Bear-D', which pinpoints targets for missile-armed ships and aircraft, and the 'Bear-F' for anti-submarine operations. 'Bears' deployed to Cuba and Angola patrol the central and southern Atlantic Ocean, whilst others have recently been based in Vietnam. The 'Blinder-Cs' are based in Estonia and the southern Ukraine for photo-reconnaissance of the sea approaches to the USSR.

Specialized anti-sub types total a further 400 or so aircraft, including the Ka-25s and Ka-27s previously mentioned. Long-range missions are undertaken by 60 Ilyushin Il-38 'Mays', similar in appearance and role to the US Navy's Lockheed P-3 Orion, and these patrol the Indian Ocean from a base in the Yemen Republic. Nearer the coast (within 370 km/230 miles), 80 Beriev M-12 'Mail' twin-turboprop amphibians fly surveillance missions, mainly for the Northern and Black Sea Fleets. The third type of ASW helicopter is the Mil Mi-14 'Haze-A', of which 100 are in service, assisted by 10 'Haze-Bs' for mine countermeasures. Naval Aviation assets are completed by about 330 training and support aircraft.

A far greater force of tactical helicopters (in the region of 3,500) is assigned to support of the Soviet army (Sukhopputnyye Voyska). The recent formation of a separate Army Aviation branch from the rotary-wing assets of Frontal Aviation has had little effect on the allocations of assault and transport helicopters to individual units, so that regiments and squadrons are assigned at all levels from Theatre of Military Operations down to Division. There are also some dedicated heliborne units.

Tactical helicopter forces are designed for close co-operation with the army in anti-tank, gunship, assault, resupply, heavy-lift and observation roles. Typical of support missions is the regularly practised deployment of troops, equipment and supplies behind enemy lines less than 20 minutes after the end of a nuclear, biological, chemical or conventional bombardment.

Prime equipment for this transport mission is the Mil Mi-8 'Hip', of which 1,600 are in service, probably now backed by the improved Mi-17 'Hip-H'. The 'Hip' carries up to 32 troops, together with AT-2 'Swatter' or AT-3 'Sagger' anti-tank missiles, machine-guns and rocket-launchers.

Defending the 'Hip' assault mission would be some of the 1,000 or more Mi-24 'Hinds' now in service. The 'Hind' began operations carrying eight troops into battle, but was soon recognized as an effective platform for anti-tank (and now anti-helicopter) weaponry. A completely redesigned nose in the 'Hind-D' introduced tandem cockpits for pilot and weapon operator, together with a chin gun turret and target-acquisition sensors. AT-2 'Swatters' have given way to laser-guided AT-6 'Spirals' in more recent versions, and allowed Soviet sources to claim a tank:helicopter loss ratio of up to 19:1 in battle training exercises.

Supporting the formidable combat team of 'Hip' and 'Hind' is the Mi-6 'Hook' heavy-lifter. About 400 of these are in service for internal or underslung carriage of guns, vehicles and supplies or 70 fully-equipped troops in the hold. They would be most likely to operate behind the front line, and could prove invaluable as a 'flying bridge' for shuttle-lifting complete mobile units over narrow obstacles such as unfordable rivers. Despite its capabilities, the 'Hook' is being augmented by the even larger Mi-26 'Halo' which, with twice the payload and a larger cargo hold, is already being regarded as a 'VTOL Lockheed Hercules'.

Yet further upgrading of the helicopter fleet will take place shortly. As if the world's largest helicopter and two highly effective combat machines were not enough, flight-testing is now in hand of the new Mil Mi-28 'Havoc'. This is an agile and potent combat helicopter (not unlike the Hughes AH-64 Apache), and sets new Soviet standards in performance and battlefield survivability.

The 'Havoc' illustrates the continued priority being given to development of rotary-wing forces in terms of their quantity and quality, and confirms the helicopter's prominence in Soviet military doctrine and tactics. Operational techniques are being refined as a result of experience in Afghanistan (where 'Hips' and 'Hinds' are used in some numbers), further honing a weapon whose devastating capabilities are often underestimated by those too easily enthralled by fast jets.

Still widely used on Soviet warships, the Kamov Ka-25 'Hormone' first entered service in 1966. It is now giving way on some ships to the Ka-27 'Helix' which employs a similar configuration. The coaxial folding rotors take up little deck space and these aircraft are often hangared whilst on ships. Their duties range from missile targeting through anti-submarine patrol to general transport. A major drawback of this type is the lack of night and all-weather sonar-dipping capability.

Used by Naval Aviation for electronic reconnaissance around NATO forces, the Tupolev Tu-16 'Badger-F' carries electronic equipment in pylons under the wings. Other versions of this aged bomber are employed on ECM, missile carrying and level bombing duties. Anti-shipping 'Badgers' carry AS-6 'Kingfish' missiles under their wings.

12 PASS.